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CHARACTERISTIC WINDCAVE SANDSTONE OVER No. 1 COAL, PIKE COUNTY.

Kentucky Geological Survey,

CHARLES J. NORWOOD, Director.

Bulletin No. 4.

The Coals of the Big Sandy Valley,

South of Louisa and Between

Tug Fork and the Headwaters of the North Fork of
Kentucky River.

BY

ALBERT R. CRANDALL, Ph. D.

Office of the Survey: Lexington, Ky.



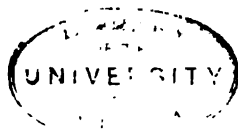
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Letter of Transmittal.

*To His Excellency, J. C. W. BECKHAM,
Governor of Kentucky.*

Sir: I have the honor to submit for publication a report by Professor A. R. Crandall on the coals of the Big Sandy Valley, south of Louisa; including, also, the region drained by the adjacent headwaters of the North Fork of the Kentucky River. The area covered comprises about two thousand square miles, and includes Johnson, Martin, Floyd and Pike counties, a large part of Lawrence and parts of Knott and Letcher counties.

The presentation of such a report at this time was rendered possible by the fact that Professor Crandall had spent several years in the study of the coals of the Eastern Field under the administrations of Professor N. S. Shaler and the late John R. Procter. The field work in the particular area here treated was begun under the administration of Mr. Procter, but was revised and extended under the present administration in 1904 and 1905.

In the earlier period of his field work, Professor Crandall was aided for a few months by the late C. Newton Brown (formerly of the Ohio Geological Survey), and for three seasons Mr. James Ira Profit, of Letcher county, served as his field assistant. About 1899 Professor Brown prepared a general account of parts of the Valley, based partly on his own observations and partly on Professor Crandall's published report on the Pound Gap region, for the report of the Chief of Engineers, U. S. Army, touching the proposed improvement of the Big Sandy. Professor Brown's report was reprinted in the report of the State Inspector of Mines (Ky.) for 1901-'02.

The report here presented does not purport to be final, though, by the liberal use of page maps and of graphic methods of presenting facts, Professor Crandall has succeeded in giving within small limits as regards text a large amount of information concerning the number, character, and distribution of the coals. With this report

as a key, the additional field work which will be necessary when the preparation of county reports shall be taken up will be much simplified.

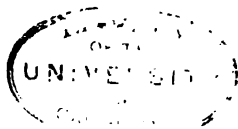
With respect to the page maps, which constitute an especially important and practical feature of the report, it may be well to call attention to the fact that they are so drawn that the heads of streams are always toward the top of the page; hence the observer is always looking up stream. This arrangement renders them particularly useful in the field.

It was desired that a section of the report should be devoted to an elaborate consideration of the coking qualities of the coals, and of the chemical and physical properties of the cokes. Unfortunately, however, sufficient data could not be obtained for this within proper time. The subject is, therefore, necessarily deferred for treatment in a special report on the coking qualities of Kentucky coals which has been undertaken. Considerable attention is paid to the coking quality of the "Elkhorn" seam in the report on the Pound Gap region, which was reprinted in the report of the State Inspector of Mines (Ky.) for 1901-'02.

Very respectfully,

CHARLES J. NORWOOD,
State Geologist.

Lexington, Ky., October 1, 1905.



INTRODUCTORY.

In preparing this report it has been the aim of the writer to put in brief form, and in terms easily understood, the essentials of the economic geology of the large region treated of. Of the plan pursued a few observations are required by way of explanation.

The page maps embodied in the report are made up from such railway and other surveys as are available of the forks of the Big Sandy river and of Johns Creek and of Beaver Creek, supplemented by the published results of the U. S. Geological Survey, and corrected and carried more into detail by my own notes in the immediate regions where geological sections have been made by the opening of economic beds, and by the examination of including rocks. It is hoped that these maps will prove accurate enough for the purpose of locating both the sections drawn at the margins, and the several openings represented. For convenience in tracing the relation of beds as opened and located on the maps with those in the vertical sections at the margin, the main streams are drawn, so far as practicable, heading towards the top of the page. Figures in parentheses, accompanying conventions for openings, indicate elevations above the local drainage; generally at some point indicated at the foot of the section. In some regions elevations above tide are given. These elevations are made up from repeated barometric observations, giving approximations of sufficient accuracy for the purposes of this report. Localities where openings have been made were chosen with reference to securing representative results, the plan being to obtain, so far as practicable, an exhibit of economic beds, more especially of the coals, from the base of the hills to the top, at intervals of from six to ten miles. This is not enough for a full exhibit of the coal resources of this field, but is the most that could possibly be done with the means at hand, and it should lead the way to systematic local development, in which it will be found

that, from the difficulties encountered in such work, some important beds have been passed over, or only partially exposed. Details of beds are not drawn to scale in the vertical sections, but measurements of coal beds made by myself, or in a few instances by field assistants (at openings driven to roof rock unless otherwise stated), are given in figures. The scale of all sections of hills is 100 feet to the inch. A uniform use of conventions for the various rocks obviates the necessity for repeated descriptive lettering. Blank spaces represent vertical intervals covered by soil or surface debris, or for which data are not at hand for filling out. Some of the more prominent coals as found, are again represented separately in enlarged section—scale three feet to the inch. Most of these beds were carefully sampled for analysis, by a cut from top to bottom unless otherwise stated, and the results, as found in the chemical laboratory of the Survey and of other chemists, are given along with the representative cuts. Moisture was determined from the air-dried samples and varied considerably with the conditions under which obtained and analyzed.

Abbreviations occasionally found necessary are as follows: S. for shale; Sl, slate; S.S., sandstone; S.S.S., shaly sandstone; L.S., limestone; Cl., clay; Fer., ferruginous; Bit., bituminous; Cal., calcareous; Concr., concretions; C., coal; C.C., cannel coal; etc.

In this, as in previous reports, areas given for any bed are districts in which the horizon of beds in question may be found. Continuity in the specific character of the bed as locally described can not be assumed from a few openings at such intervals as has been found practicable in the prosecution of the work of the Survey.

A few slight errors and omissions in the engraved plates will be noticed by the reader.

Such terms as formation, series, etc., are used in the popular, rather than in the technical, sense.

GENERAL GEOLOGY AND TOPOGRAPHY.

The geology of the territory drained by the Chatterwah or Big Sandy river, with the exception of a part of the valley of Big Blaine creek, as described in a report on Greenup, Carter, Boyd and a part of Lawrence, and a considerable portion of Paint Creek valley as described in a report on Morgan, Magoffin and Johnson counties, and a narrow belt along the Pine Mountain fault, is that of the Coal Measures above the Conglomerate formation. In a large part of the region included in this report, the horizon of Coal No. 1 of the Greenup and Carter report is at the base of the hills along the main water courses. For reasons which will appear in the discussion of the order of the beds in the different localities, no attempt will be made to number the coals of this part of the field as in that report.

The question of nomenclature of beds is perplexing to say the least, since from the nature of the case no particulars of any region can be assumed in advance to be repeated in identical order as found elsewhere or in general. The difficulty of adopting something like a uniform method of designating coal beds over a widely extended field is inherent in the varying conditions which has attended the deposition of beds in the various parts of a great field. Divergent views or interpretations from different points of view have not tended to clear the way for a nomenclature which has in it the advantage of a helpful comparative view of the several parts of the Eastern Coal Field, which covers parts of eight States.

The numbering of coal beds from the base of the Coal Measures upward, or in the several divisions of the Coal Measures when extended over adjacent regions even, proves to be impracticable or misleading from the assumptions required as to the equivalency of beds with the progress of the development of a field; so, also, the nomenclature of any one part of the field at large will necessarily be misleading for another from the equivalencies which are thus as-

sumed without warrant of more than a probability of a continuity of the several beds of the two regions.

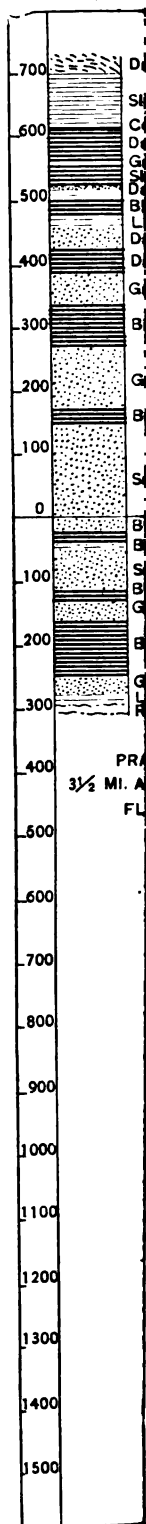
The use of local names to avoid misleading assumptions has its lack of suggestiveness and its multiplication of designations which, to the general reader, are in an important sense without meaning.

The late Dr. Orton, of the Ohio Geological Survey, in an admirable discussion of the difficulties in the way of a suitable nomenclature (Vol. V., Ohio Geol. Survey), concluded that priority of designation might be allowed to lead in the solution of this vexed question, and so followed the nomenclature of the earlier developed Pennsylvania coal field. This is much easier for the Ohio field than for the Eastern Kentucky field, in which south of the counties near the Ohio river not much more than a semblance of the Pennsylvania or the Ohio general section is found in the character and succession of rock and economic beds.

The younger geologists of the U. S. Geological Survey in reports on the areal geology of parts of this field appear to have adopted the plan of giving local names to geological features generally. This has the minor advantage of not assuming relations to beds of adjacent fields, but it results in the multiplication of distinctions which do not distinguish and of names that do not designate; a tendency which in local geology may be in a sense pardonable, but which is a questionable contribution to science.

That a fuller development of the several parts of the Eastern Coal Field will facilitate a comparative study of beds and lead to a more uniform nomenclature should be expected. A recent paper by Prof. Stevenson, of the University of Pennsylvania, looks in this direction; but as it is not yet apparent that the typical order of beds for this field as a whole is found in the general section of Pennsylvania, it is too early to adopt its designations of beds for so large and so diversified a field.

Of the irregularities of the beds below the drainage, as disclosed by drill wells, some account may be desirable for an intelligent view of the Eastern Kentucky Field.



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The outcrop of the Devonian Black Shale,* and the Lower Carboniferous shales and sand rocks (the Waverly group in Ohio and Kentucky reports), on the southeastern slope of the Cincinnati Anticlinal (the Silurian bluegrass tableland of central Kentucky), has been described in various reports on counties along this belt; as also has the Subcarboniferous Limestone next and below the coal-bearing series. For convenience in description, the coal-bearing rock series may be separated into two parts—the so-called Conglomerate formation, or the Conglomerate Measures, overlying the Subcarboniferous Limestone, and the Coal Measures above the Conglomerate, a large part of which will be treated of in this report.

Southeastward from the border outcrop of the Conglomerate formation drilled wells show a lack of regularity in the thickening of the beds, already mentioned, which may at least seem to make the equally striking irregularities of beds above the drainage, less questionable as matters of record.

The accompanying plates (A and B) of drilled-well sections, show some of the leading facts in the stratigraphy of the formations in question. Some of the minor details are omitted to permit a reduced scale for a readier general comparison. It should be understood that all records do not make uniform distinctions between rocks as they appeal to the eye of the observer from the exposure at the surface. For this reason it may be somewhat a matter of opinion as to what beds should be included in a given formation, but the exhibit is none the less interesting and suggestive as to the series as a whole, and as to the local conditions which attend the deposition of the beds as they are found in the several localities.

The Conglomerate formation of these well sections is for the most part a coarse sand-rock, rarely a true Conglomerate with imbedded quartz pebbles, as noted at points in the Pine and Cumberland mountains and also as noted in its northwestern outcrop at various exposures; and it will be seen that the coarse, hard sand-rock is in

*Ohio Shale of N. S. Shaler and Andrews. In large part the equivalent of the Chattanooga Shale of the U. S. Geological Survey.

part replaced by shale and slates locally, or that the usual shale beds which mark the division of the formation into several members are reduced in prominence or replaced by sandstone. As seen at the surface, the sand-rock of this formation is cross-bedded and weathers in ragged ledges and cliffs so characteristic as to be readily recognized in the topography of the belt in which exposed.

The absence of prominent coal beds is also noticeable, and especially so by comparison with the formation in other fields in Kentucky and West Virginia and Tennessee. This is noticeable also in the Breaks of Sandy, where nearly the whole thickness of the formation is exposed in the water-gap cut by the Russel Fork through the Pine Mountains, the Conglomerate barrier ridge between Kentucky and Virginia. The estimated thickness here is between 1,400 and 1,500 feet in which only thin coal beds are exposed. There being, however, one or two beds three feet or more in thickness in the upper member or in the upper member and in the overlying shales, on the Virginia side, a feature not shown in the well sections.

The Subcarboniferous Limestone is shown to be variable to an extent that could hardly have been anticipated; though along the outcrop in Ohio and in Greenup county, Ky., it is entirely wanting in intervals between lenticular masses of greater or less local importance.

Southward, however, along the Kentucky outcrop, from Carter county to the Mt. Vernon region, it steadily increases in thickness from 25 feet or less to 250 feet or more; and along the Pine Mountain fault, between Kentucky, Virginia and Tennessee, this formation is a constant feature with the maximum of about 350 feet in thickness.

The Cedar Creek and head of Mud Creek wells, in Pike county, show very little if any rocks that would be recognized as Subcarboniferous Limestone, except by relation to the Conglomerate formation above. In the latter well section, 8 feet of calcareous sandstone and 25 feet of ferruginous slate or shale is all that can be referred to this limestone member of the Lower Carboniferous formations.

On the Burning Fork, W. Va., near Warfield, this formation is also represented largely by transition beds, showing the northeast-southwest trend of this basin of exceptional sedimentary conditions. The Brushy Creek section, in lower Pike, shows a large body of gray limestone characteristic of this formation extending into or across this basin.

Respecting the Conglomerate Measures, the thickness at the northwest outcrop, the record of drill wells and the Pine Mountain exposures, indicate an increase in thickness of about 1,000 feet from Carter, Elliott and Morgan counties southeastward to Pine Mountain. The increase in thickness of the Subcarboniferous Limestone (mostly St. Louis group), from less than 100 feet in Carter county to more than 300 feet in Pine Mountain, is offset by the corresponding decrease in the Waverly Group, (the Lower Carboniferous sandrock and olive shales), from 500 feet in Carter county to about 200 feet in the Pine Mountain; while the Devonian black slates or shales have a probable thickness averaging 100 feet or more throughout.

There are neither very striking dips nor local disturbances in the region to be treated of in this report. The general inclination of beds is northwestward, with local variations, conforming to the direction of the drainage, as has been noticed in all of the principal drainage systems of Eastern Kentucky. The general northwestward dip is limited below the drainage to the upper member of the Conglomerate Measures. The strata below dip to the southwestward with increasing inclination downward to the top of the Waverly Group, or of the Lower Subcarboniferous division, from the wedge shape of the members of the Conglomerate series and of the Subcarboniferous Limestone. The northwestward dip is also increased upward in the measures above the Conglomerate, by the thickening of beds to the southeastward; but the lack of continuity of beds in recognizable character renders it difficult to obtain exact data for a detailed account for the several geological levels either below or above the drainage.

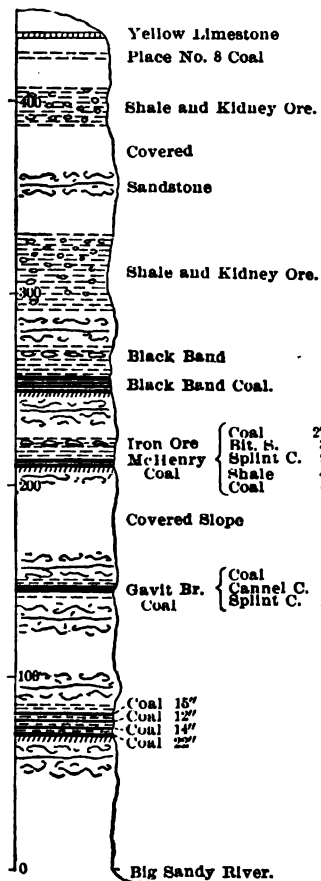
From the occurrence of shales and friable sandstones alternating

with hard sandrock, the hillsides are generally benched by ledges, or in places by cliff walls, of sandstone durable enough to resist the eroding agencies by which the slate and more pliable sandrock have been worn into arable slopes. Rock-houses are of frequent occurrence, reaching across ravines, along creeks and branches, and on more exposed points and hillsides. These rock-shelters are comparatively small, rarely more than shelving rocks, in no distance showing the imposing dimensions of the rock-houses in the region of the Rockcastle river, and on the south fork of the Cumberland, mentioned in a report on Whitley county, etc. The points of projecting spurs are frequently marked by a succession of hedges and cliff-points; the latter sometimes taking the anvil rock form; as is especially well illustrated on the point between Caney and Little Brushy Creeks in Pike county, and also at the forks of Blackberry creek. The hedges along the hillsides are occasionally broken into standing rocks or rude towers. This is noticeable along the benches both above and below the Elkhorn coal-bed on some of the creeks in the upper Pike county region. The tops of the ridges are frequently capped with stubborn masses of coarse sandrock, exhibiting jagged and surprising forms of resistance to erosive agencies. It is greatly to be regretted that some of these curious rock-histories of erosion have not been photographed for purposes of illustration. Level land is confined to narrow and irregular limits along the main streams, excepting occasional table plats on the hilltops. All of the land was originally heavily timbered. A considerable part of the timber growth still remains on the ridges so that, except along the larger streams, the traveler sees a succession of forest-covered hills with only occasional farm clearings on them. The natural resources of this country point to mining, lumbering and manufacturing as the coming industries, rather than general agriculture. The acreage of the great coal-beds which have been traced across this field is enlarged by every topographical feature that limits the area of natural farm land. With the development of these industries the limits of profitable agriculture and horticulture will, as a matter of course, be greatly extended.

It is evident, however, that the dictates of a sound policy should preserve a large percentage of a hill country like this in woodland. To keep the flood tides in the larger valleys within limits essential for their successful cultivation requires this, as is already in course of demonstration. This subject is treated somewhat at length in Part III, vol. 3, second series, Kentucky Geological Survey reports, by Prof. N. S. Shaler.

ECONOMIC GEOLOGY.

In the report on Greenup, Carter, Boyd and a part of Lawrence, a belt of country having a northward dip of 50 feet or more to the

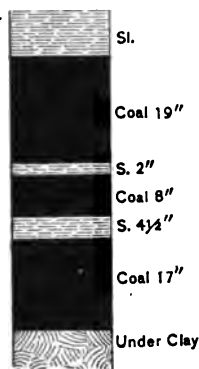


Big Sandy River Section
opposite head 3 Mile Cr.

mile was described as extending from the Dry Fork of the Little Sandy river, above Willard, to the Levisa region and eastward into West Virginia. Southward from this belt, which is from 8 to 10 miles wide—or from Warfield on the Tug Fork, and East Point on the Levisa Fork—with a number of wavelike undulations, the general dip of the rocks immediately above the Conglomerate is no more than the fall of the river. To this general statement a belt along the Pine Mountain axis is an exception. Tracing the coal-beds southward from Louisa where Coal No. 6, of the report referred to, is near the high-water line, the beds below successively appear above the drainage, so that at Peach Orchard the series begins with No. 2—No. 3 being the Peach Orchard bed. Two hundred and fifty feet higher in the series is the Richardson coal, under a coarse sandrock, at some points showing

embedded quartz pebbles, and generally recognized as the cliff-forming sandrock above Coal No. 8 of the above report. Openings formerly made by Col. Jay H. Northhup, General Manager at th time, of the Ohio & Big Sandy Railroad, along the river below old Peach Orchard, show the order of beds to be as in the section here introduced for comparison with those of the page plate

following. The Gravit Branch coal appears to be the representative of the Whitehouse cannel coal, showing here 6 inches of cannel and 11 inches of splint or seme-cannel coal. The McHenry coal is the Peach Orchard seam, and the Black Band coal is apparently at the horizon of No. 5 of Carter and Lawrence counties, this part of the section being shortened.



HD. OF DONOTHAN CR.
LAWRENCE CO. KY.

In the ridge east of Three-mile Creek on the head of Donathan Creek of Tug Fork, this coal shows a much better section, as in the annexed cut. Analyses of average samples from the several benches are here given:

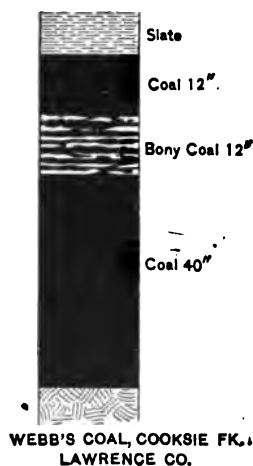
	Upper 27 in.	Middle 15 in.	Lower 17 in.
Moisture	6.00	8.00	8.00
Vol. comb. matter . . .	82.40	86.40	86.00
Fixed carbon	57.40	52.40	47.00
Ash	4.20	8.20	14.00
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>
Sulphur	.499	.961	4.714

About one-third of the lower bench is good coal with 6 per cent. of ash only, and less than 2 per cent. of sulphur.

Recent developments in Lawrence county on the several tributaries of Cat Fork and on Cherokee Creek show this coal as in the following sections:



YOUNG'S COAL,
CHEROKEE CR.
LAWRENCE CO.



WEBB'S COAL, COOKSIE FK.,
LAWRENCE CO.

Young's coal, in the ridge between Cherokee and Irish creeks, shows this bed at its best in thickness and quality. On the Perkins fork of Cherokee it is in benches of 15 to 20 inches, separated by as much slate and shaly coal; and Webb's coal, in the Cat Fork region, shows a maximum of available coal, though a greater thickness of alternating coal and slate is found at a few points.

West of Levisa Fork, opposite Torchlight Station (Three-mile Creek), a splint coal is opened at the mouth of Stratton Branch, 175 feet above the river bed, showing three feet of splint coal. In the ridge between the river and Lick Creek, which empties into the river, a body of coal is found 60 feet higher in the hill; it has been opened at several points on both sides of the ridge and is known as the Watson seam, having been developed by Dr. Watson, of Louisa. This seam is in two principal benches, the upper of which varies,

as opened, from 48 to 60 inches of good coal. The lower bench, separated by slate partings, 5 to 6 inches at three openings and 4 feet at a fourth, is about 46 inches thick.

Following is an analysis of a sample taken from the upper bench where the bed is opened on Lick Creek, west of the ridge, and driven to solid coal. Analysis was made in the State College laboratory:



Watson Coal.
Stratton Br.
Levisa Fork

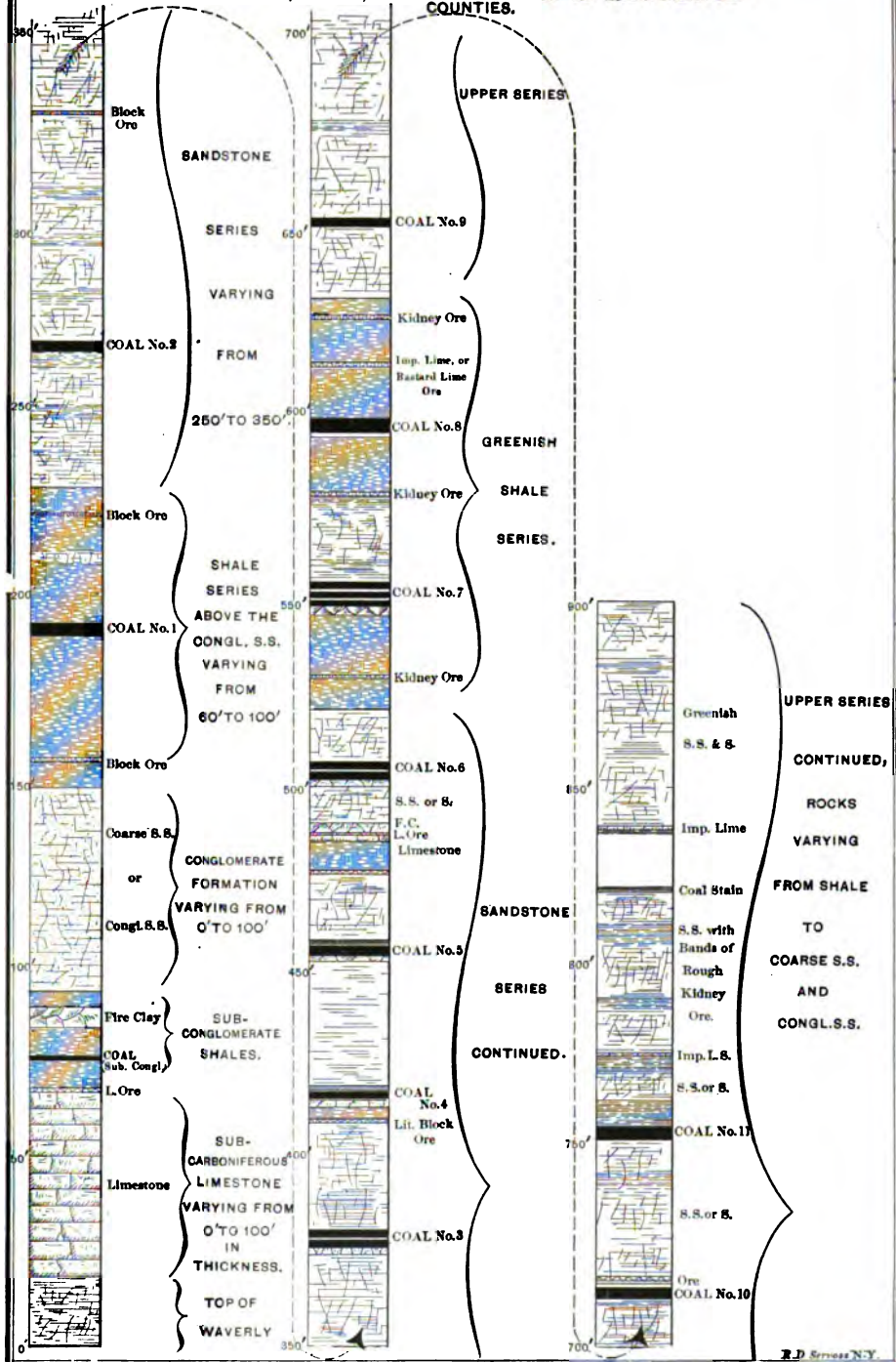
Analysis of Watson Coal.

Water	4.80
Volatile comb. matter	36.84
Fixed carbon	49.82
Ash	8.54
	100.00
Sulphur	0.74
Specific gravity	1.319

The equivalency of this bed is in doubt. It is about 45 feet below a sand-rock of considerable thickness, the interval being shale and shaly rock, with kidney iron ore imbedded at several levels, as in the shales above coal 6. As

PLATE NO.1

GENERAL SECTION
FOR
GREENUP, BOYD, CARTER & PART OF LAWRENCE
COUNTIES.



1925

the ore-bearing shales are reduced to uncertain proportions in the series in this region, and the coals included have disappeared or lost identical features, it remains to be determined what horizon this bed represents, with some probability that it is, like the Cherokee and Cat Fork Coal previously described, a thickening of coal No. 5 of the General Section.

It offers a good opportunity to make use of slack water transportation to the river towns of the Ohio Valley. Down Lick Creek and down the Levisa Fork this bed falls with the dip already mentioned to near or below the river level at Louisa, thinning out in that direction.

The limestone ore and the horizon of the ferriferous limestone of the Hanging Rock region appears to be represented in the Three-mile Creek region by a band of flat, kidney-like blocks of iron ore, imbedded in highly ferruginous bituminous slate, with thin layers of coal, the whole having a thickness of a foot or more, and carrying 30 per cent. of metallic iron (results of previous examinations, vol. A, Chem. Report, page 280). Coals 6 and 7 are thin or wanting in this locality, but the kidney ores, beginning with this part of the General Section, appear to hold as in Boyd county, and were formerly mined along the railroad in the valley of Three-mile Creek, and shipped to Ashland. The yellowish earthy limestone near the top of the hill is the lower of the three beds of Boyd and the northwestern part of Lawrence. It is the Shawnee Buff Limestone of the Ohio reports. If, as supposed, the Richardson coal is the equivalent of Coal No. 8, its place would be below the limestone, as indicated in the section. The interval between the Peach Orchard seam and the Richardson coal is generally about 250 feet. Some of the hills in this region are several hundred feet higher than the one represented by the section. For purposes of comparison, the General Section of Greenup, Carter, Boyd and the northwestern portion of Lawrence is here reprinted. Those who have an opportunity to compare it with the general section of the Ironton region as in Vol. III. of the Ohio reports, will find that this section is in

many respects like that across the Ohio river in southeastern Ohio. It also shows most of the important features of the Ohio coal field as a whole, though the designation of beds is not the same.

The Richardson-Whitehouse Region.

In the region including Richardson and Whitehouse (as in the region already described), there is shown some considerable departures from the order of beds in the general section of southern Ohio and the adjoining field in Kentucky. These changes will be more fully noted in the regions to the southward.

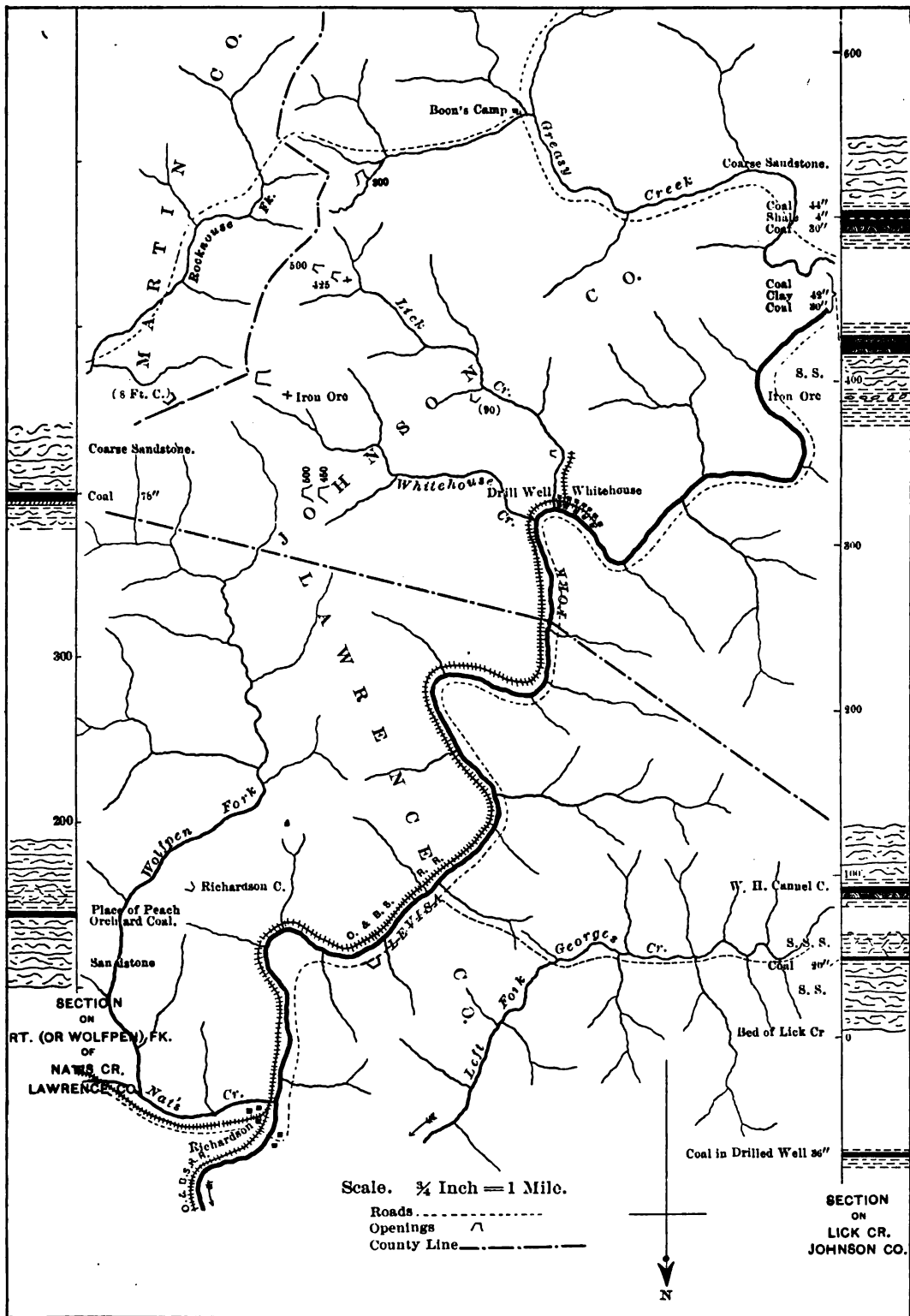
The page map which is here introduced as a part of the description of this part of the field, extends to the Peach Orchard district; and the Wolf Pen Fork section on the left of the map is, in what is shown, practically the Peach Orchard section omitting the lower beds. The Richardson coal decreases in thickness northward, however. As opened on Burgis Branch by Mr. Lucien S. Johnson, when superintendent of the Peach Orchard mines, the bed-section is given as follows:

Roof, thick bedded sandstone.

Bituminous shale	7 inches.
Coal	18 "
Shale parting	7 "
Coal	8 "
Shale parting	8 "
Coal	one foot or more, not well faced up.

The Peach Orchard mines and coal are too well known to require special description in this connection. Analyses have been recently made of samples from the upper and the lower benches of this seam, 49 inches, and from the clay portion of the parting, 7 inches. They are as follows:

The Coal.	Upper 21 inches.	Lower 28 inches.
Moisture	4.52	8.00
Volatile combustible matter	34.68	35.60
Fixed carbon	56.80	57.80
Ash	4.00	8.60
	100.00	100.00
Sulphur	0.521	0.658



RICHARDSON-WHITEHOUSE REGION.



The Clay Parting.

Silica	55.60
Alumina, with traces of iron oxide	80.04
Lime carbonate	1.74
Potash	.20
Soda	.40
Moisture, etc.	10.82

The samples were taken in 1891 from near the head of the main left entry of the mine, on the opposite side of the valley from the entries from which samples previously reported on were taken. These results are eminently satisfactory. The clay approaches more nearly the composition of the flint clays than is usual for shale clays, while the coal is above the average of the standard coals of the market. Southward this coal-bed is reduced in value by slate and clay partings, though the thickness is increased in some localities.

The openings of the Richardson seam on Wolf Pen Fork, and also across from the head of this fork on the waters of Rockcastle Creek, were made under the direction of Geo. S. Richardson, and a block showing the thickness of the bed at the latter place was exhibited at the Centennial Exposition. An analysis of this coal is as follows:

Moisture	8.50
Volatile combustible matter	31.94
Fixed carbon	52.06
Ash	12.50
	100.00
Sulphur	0.873

Northward, towards the mouth of Wolf Pen Fork, the thickness is 78 inches. The ash is increased in percentage, as is indicated by tests of coal from the opening about two miles from Richardson Station.

The coal openings in the Whitehouse vicinity were made at the mouth of Lick Creek by Mr. Robert Ellwood, under the direction of Col. Jay H. Northup. They do not expose all the coals of the region, but serve to give the vertical section of most of the features needed for comparison with that of other localities. The canal

coal is now recognized as Coal 2A. of the Greenup General Section. This cannel is noted in the report on Morgan, Magoffin, Johnson and a part of Floyd in connection with other cannel deposits at the same horizon in adjacent territory (page 15, and plates III and IV of that report). Cannel coals are in strong contrast with beds of ordinary bituminous coal in the matter of areal extension. Much as the hope that a fine exposure of cannel is an economic feature of the region in general may appeal to the imagination of the observer or of the owners of the land, it is consistent with a careful study of many such deposits to say that they are local; more frequently at the horizon of certain beds, as Nos. 2A and 4 of the General Section, but also locally replacing or added to the thickness of other beds. (See in tabular view of coal-beds the number of beds with local cannel coal deposits. Report on Geology of Greenup, Carter, etc., p. 74.) The Whitehouse cannel, improperly called the "birdseye" cannel so far as its fracture is concerned, showed a thickness of 18 to 30 inches as mined. It is an excellent grate coal and therefore for household purposes in general; most emphatically so for the kitchen range, for which, with intelligent use, it combines the advantage of both wood and coal. A representative measurement in the first main entry was 25 inches of cannel under 18 inches of common bituminous coal, and separated from it by 2 inches of bone coal or earthy cannel. Chemical analysis is as follows:

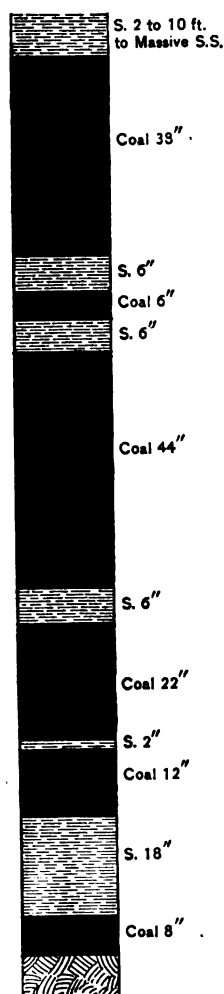
Analysis of Whitehouse Cannel.

Moisture	1.20
Volatile combustible matter	41.80
Fixed carbon	46.00
Ash	11.00
Total	100.00
Sulphur	0.901

Coal No. 1 is here below the bed of the river, 36 inches thick as shown by a core-drilled well. The same thickness is shown by a core section one mile up Lick Creek, and over the ridge, on waters of Greasy Creek, 44 inches, as reported by Mr. Robert Ellwood. The

upper coal of Lick Creek section is the equivalent of the Richardson seam.

Openings along the ridge to the southward from the head of Whitehouse Creek show an increase in thickness, reaching a maximum as shown in the accompanying cut, from measurements by



Prof. C. W. Brown, formerly assistant on the Kentucky Geological Survey. This is the F. coal of the region at the head of the Middle Fork of Rockcastle Creek (see "Broas Coal Region"), and the "10-foot" coal of Greasy Creek, as in the following pages. Sample for analysis was taken from an entry at the head of the Right Fork of Whitehouse Creek from two benches aggregating 71 inches of coal. One foot of slaty coal, not included in this measurement, is left in the roof in mining. The cover in this region is about 75 feet of coarse, massive sandrock, in a narrow ridge. Following is an analysis of the coal, made in the laboratory of the Kentucky Geological Survey of a sample collected April 24, 1905:

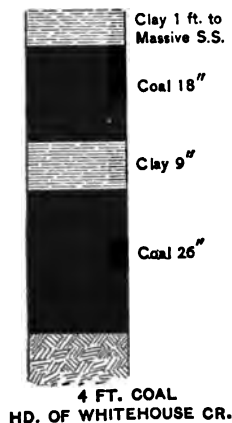
Analysis of Upper Coal, Head of Whitehouse.

Sample from two benches, representing the whole bed, with slaty coal of the roof omitted. Analysis by S. D. Averitt:

Moisture	3.55
Volatile combustible matter	34.29
Fixed carbon	54.40
Ash, yellowish white	7.76
	100.00
Sulphur	0.71
Specific gravity	1.260

Fifty feet below the "8-foot" seam and under a massive sandrock largely filling the interval, is found the "4-foot" bed of this region.

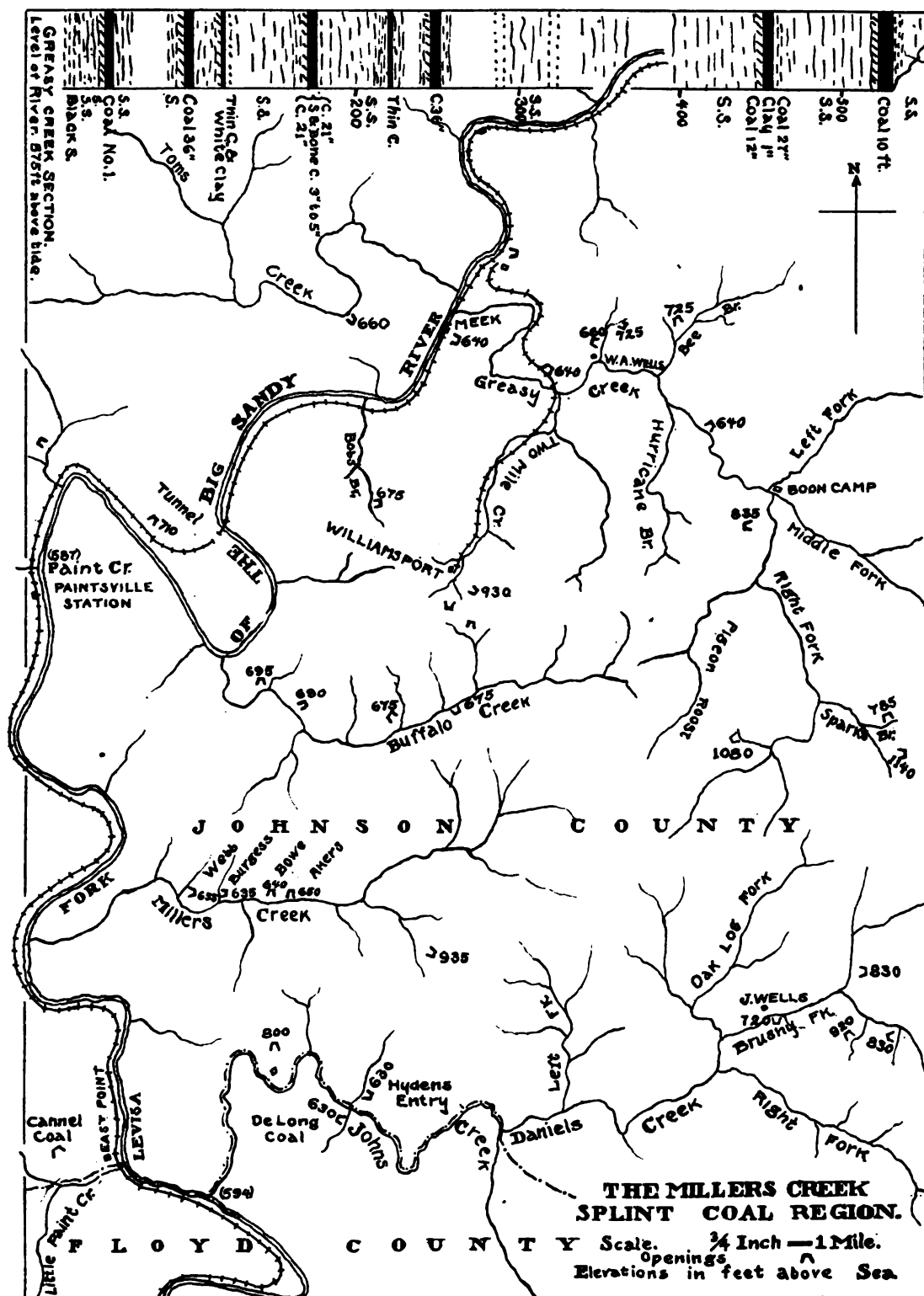
The bed-section shows: Lower bench, 29 inches of coal; parting of slate, $7\frac{1}{2}$ inches; upper bench, 19 inches of coal to sandrock. This coal seam is not known in the region to the southward.



The Peach Orchard bed appears not to be represented here by a prominent coal, though the section for the Peach Orchard district, the one at Paintsville (report on Morgan, Magoffin, Johnson and a part of Floyd, plate IV.), and that at the head of the Middle Fork of Rockcastle Creek (on a following page), all adjoining districts, have this bed and another prominent coal in that portion of the Whitehouse section which is left blank. An exposure of bituminous shale noted at the head of Lick Creek is probably at the horizon of the Peach Orchard seam. The kidney ore in shale at the 400-foot level represents, in decreasing prominence, the kidney ore horizon of Three-mile Creek near Torchlight Station.

The Miller's Creek Splint Coal Region.

This region is one in which the No. 1 coal is above the main drainage, and where it is a splint coal of more than local importance. In the Whitehouse region, as previously stated, this bed is below the main drainage. From about one mile below the mouth of Greasy Creek, conformably with the Paint Creek uplift (which extends eastward across the Levisa Fork), this bed rises above the river to a level which is 125 feet above low water, or about 710 feet above tide water. The southward dip is less marked and merges into the general northwest dip, with this coal horizon above the Levisa Fork, as previously noted. This region, in which the lower coal is more specifically a splint coal, though not uniformly so, includes Greasy, Buffalo, Miller's and Daniels' creeks, east of the Levisa Fork, and the vicinity of Paintsville westward, as a workable thickness may be developed.



This coal is not so prominent in thickness as other coals in this and neighboring regions, but it is sufficiently marked in character to warrant a regional description, with its relation to the other beds of the General Section.

It is at its best, so far as developed, on Miller's Creek, where it is about 60 feet above low water in Levisa Fork at the mouth of the creek. The bed-section at openings near the main creek is without parting and shows 50 to 56 inches of splint coal. The seam falls below the creek about three miles from the river. On John's Creek at the 630-foot level, as indicated on the region map, with less uniform splint structure, the thickness is from 47 to 52 inches. On Buffalo Creek, at elevations varying from 695 to 675 feet above tide, the average thickness is 36 inches. The Wheeler bank on the Levisa Fork, one mile below Paintsville, shows from 50 to 55 inches about 710 feet above tide and 125 feet above low water in the river. The thickness on Tom's Creek is from 36 to 42 inches, and on Greasy Creek and Bob's branch at elevations varying from 675 to 640 feet above tide, it is 32 to 40 inches at points seen. The upper half of the bed only is splint at the mouth of Greasy Creek, and the dip down the river is about 45 feet in three-fourths of a mile—or from Meek Station, where the Meek Coal Company's mines are located, to the J. S. Rittenhouse mine 30 feet below the railroad grade at Ward Station. The extension of this bed as a splint coal up and down the Levisa Fork is probably limited to this region. An analysis of this coal, as represented by the Wheeler bank, made by the Survey, gives the following, to which is added result of an analysis reported by Joseph Sillyman:

Analysis of Wheeler Coal.

	By Survey.	Sillyman's Report.
Water	2.66	2.600
Volatile combustible matter	88.04	40.120
Fixed carbon	56.80	52.964
Ash	8.00	8.270
	100.00	98.954
Sulphur	1.218	1.046

Analyses of samples from Miller's Creek, the Burgess opening on a branch at 645, and Bowe's entry one-half mile up the creek, by Wuth of Pittsburg and by McCreath of Philadelphia, give the following results:

Thickness	Burgess Coal. 51 inches.	Bowe Coal. 56 inches.
Water	2.412	1.29
Volatile combustible matter	88.498	85.95
Fixed carbon	56.713	58.413
Ash	1.880	3.270
Sulphur	0.557	0.581
Phosphorus	0.008	0.006

The coals above the splint seam follow in order approximately as shown in the regional section, which is made up from openings at points on Greasy Creek. The 2d and 3d coals are opened at W. A. Wells' place, above the mouth of Two-mile Creek at 660 and 725. The latter is the horizon of the Whitehouse cannel. It is here and on Bee Branch a splint coal. On the Sparks Branch of the Right Fork, as imperfectly opened at 785, this bed shows 24 inches of slaty cannel coal. The 4th coal, at elevation 835 on the Right Fork, is opened by an entry driven 50 feet under roof-rock and shows 18 inches of splint or hard laminated coal with equally as much soft coal forming the upper half of the 36-inch bed. This bed appears to represent the Peach Orchard seam, though quite unlike that bed in its southward extension. If this be correct, then 30 to 50 feet above, under a sandrock ledge, as indicated by dotted lines in the vertical section, is the place of the cannel coal of Two-mile Creek at the 930-foot level. The rise of the beds up Two-mile Creek is 75 to 90 feet, conforming to the northern slope of the eastward extension of the Paint Creek uplift. The Two-mile Creek cannel coal is mined by the Sandy River Coal Company, and carried by tram-road to the Chesapeake & Ohio Railway at Ward.

It is at the horizon of the East Point Cannel near the mouth of Little Paint Creek, which is about 320 feet above the river and locally a thick cannel, having a maximum of 52 inches. Entries of the Two-mile cannel show 18 to 23 inches of good cannel overlaid by 20 to 22 inches of soft coal.

Analyses of this and the East Point cannel, made for the owners, are as follows:

	Sandy River Co's. * Two Mile Cannel.	East Point Cannel.
Water	0.75	1.420
Volatile combustible matter . . .	53.69	55.080
Fixed carbon	39.64	36.266
Ash	5.10	6.800
	99.18	99.016
Sulphur	0.82	0.984

The dotted lines 320 feet from the base of the Greasy Creek section indicate the place in the series of the "Broas coal" of the adjoining region to the south and east. This bed is shown at the Goble opening on Miller's Creek, at the 935-foot level. The bed-section, as measured by Sillyman, is 64 to 70 inches of block coal, without parting. Analysis, also reported by him, is as follows:

Water	8.720
Gas	38.840
Fixed carbon	51.268
Ash	6.000
	99.828
	0.677

The "40-inch" coal higher up in the series was recently opened on the Right Fork of Greasy Creek, at the 1080-foot level. It is placed in the section approximately, and is supposed to represent the 4-foot coal of the Whitehouse region. It is part splint and is a good coal.

The upper coal in the series, as found in this region, was recently opened in the ridge at the head of the Sparks Branch of the Right Fork, showing a weathered bench 10 feet thick, with very little cover. This is the "8-foot" bed of the Whitehouse region; also the thick bed of the Rockhouse Fork of Rockcastle Creek, and the F. coal of the "Broas Block Coal Region" to the southward on the head of the Middle Fork of Rockcastle Creek.

The coals next above the No. 1 are not opened on Buffalo Creek. From outcrops which were noted at several points, it appears that the

*As reported by Mr. D. C. Boyce, Expert on Coal and Iron for the World's Columbian Exposition, 1903. Analysis of sample by J. S. Cary, Chemist in Charge.

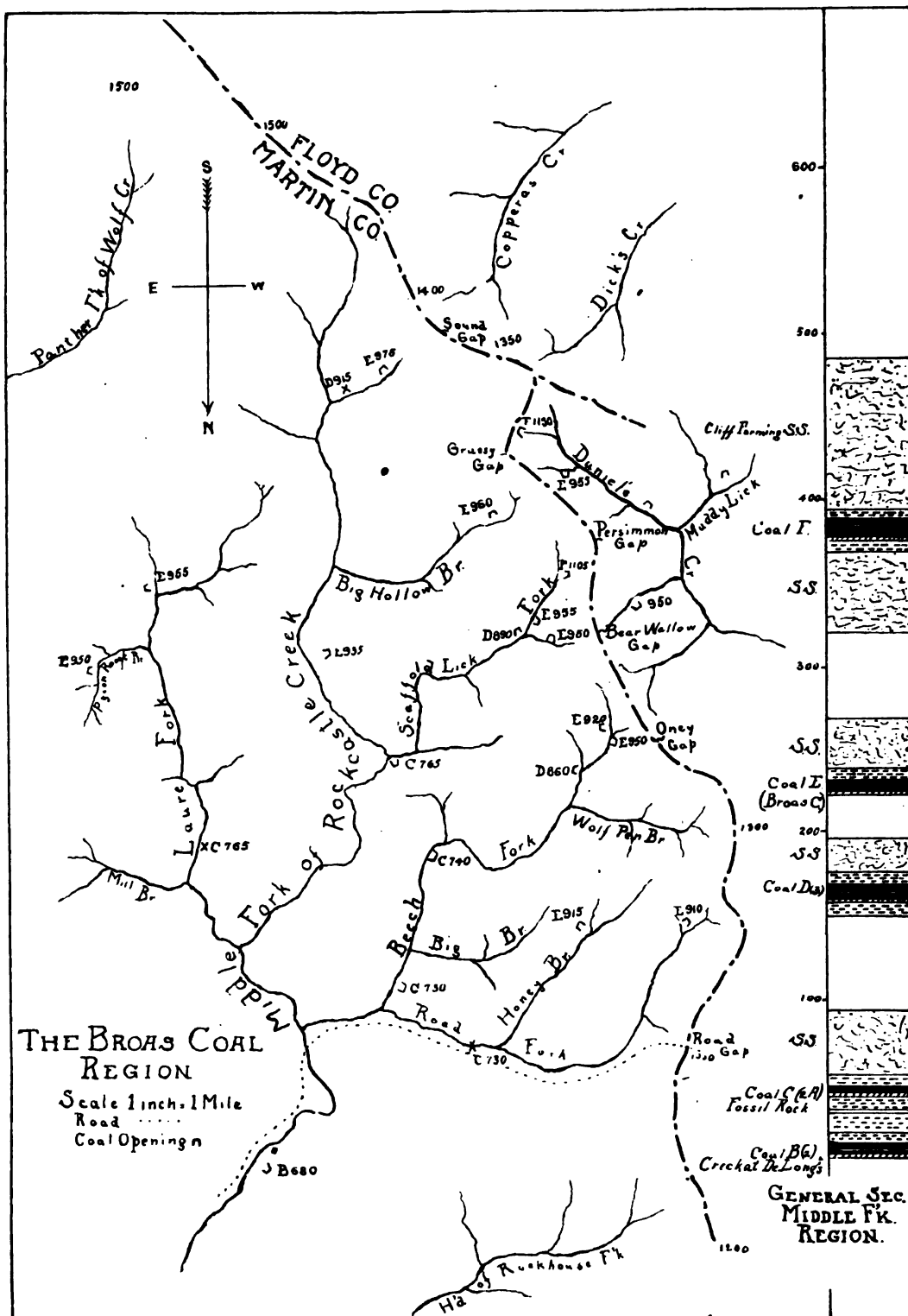
intervals are increased considerably, and this is also shown on Daniel's Creek; but the barometric elevations are given here with some reservations in consequence of the stormy conditions under which they were taken. The order of the beds is essentially as on Greasy Creek. The splint coal, at 800 on John's Creek and 830 on Daniel's Creek is at the lower cannel horizon; at 800 feet the bed-section shows 6 inches of coal at the top of 36 inches of splint coal, which is separated from 24 inches of coal below by 20 inches of shale.

On the road to Beech Fork, above J. Wells' place, the bed at the 830-foot level, known as a cannel coal, is 56 inches, under a sandstone ledge 10 inches at the base being a splinty cannel and the upper 46 inches more nearly a splint coal. The Peach Orchard bed is opened in this locality nearly 100 feet higher up, showing slate partings. The upper coals are opened towards the head of the Right Fork, as shown on the next regional map.

Up John's Creek few openings have been made to show the continuity of beds. At Morgan Clark's, nearly two mile above the mouth of Daniel's Creek, and at 360 feet above the creek, 45 inches of block coal is shown, excluding two partings which increase the bed to 50 inches. This is the Broas seam reduced in thickness. The No. 1 coal is easily traced to the Prestonsburg region, where it has been mined for home consumption and for shipment by river from an early day. The place of the cannel horizon is indicated by an opening at Brandy Keg Gap, developing a slaty cannel about 90 feet above the Prestonsburg seam.

Head of Middle Fork of Rockcastle (Broas) Region.

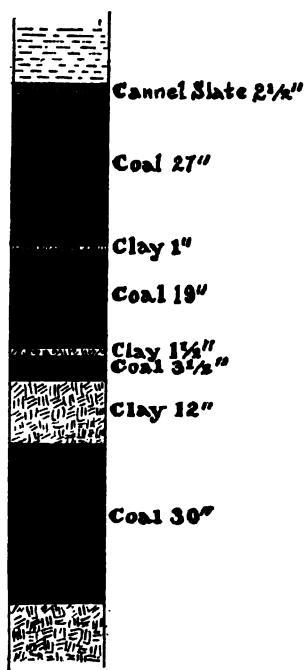
The region at the head of the Middle Fork of Rockcastle Creek, including the heads of Daniel's, Dick's and Copperas Creeks, is a district in which a block coal is especially prominent. This bed is not with certainty referred to any of the extended coal horizons to the north and west and it loses its character and thickness southward. As the coals of this region were developed under the direction of Mr. R. M. Broas, this block seam has come to be known as the



"Broas Coal." Other beds of the series are also prominent in this area, and so much has been done to trace all the coals of the region that the vertical section therefor presents the serial order of beds with a completeness that gives it special value as a new basis of comparison for regional sections to the southward. The page map of this region* is made up from surveys made in the course of study of the coal deposits. The local designations of beds are given, with the serial number in some instances in parenthesis, to show relations to beds to the north and west. The "F." coal is without doubt the 8-foot bed of the Whitehouse region, and in such relation to the massive sandrock above and the kidney iron-ore bearing shales below (reduced to nearly the last recognizable stage of disappearance

southward), as to suggest, with considerable probability, Coal No. 8 as its equivalent, as previously indicated. The elevations above the sea level are approximate, but serve the purpose of showing the direction of the dip of the beds.

The coal at the base of the section may be regarded as equivalent to the three beds at the base of the section on Big Sandy river given on a previous page; but here it is separated by comparatively thin partings, as shown in the detailed section. Analysis of a sample from the whole bed shows an unexpected percentage of ash, for which conditions under which the sample was taken partly account. An average sample from openings of this coal on



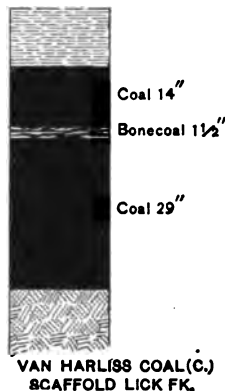
1 mi. below mouth Beech Fk. Beech Fork shows less ash.

*See page map. "The Broas Coal Region."

Analyses.

Moisture	2.42	8.24
Volatile combustible matter	82.92	86.69
Fixed carbon	49.86	52.06
Ash	14.80	8.01
	<u>100.00</u>	<u>100.00</u>
Sulphur	2.880	0.837

The bed next above, ("C," or 2A of the General Section), is in the place of the cannel coal of the Whitehouse region. It is splint in structure, but has a large proportion of fixed carbon and makes a strong coke.



On Scaffold Lick Fork this bed is forty-four inches thick, as in the detailed section here given. Samples for analysis were taken from openings on Scaffold Lick above bed 755, and on Beech Fork where the thickness was forty inches without parting.

	Van Harliss.	Beech Fork.
Moisture	2.86	3.52
Volatile combustible matter	80.58	27.28
Fixed carbon	58.56	61.20
Ash	8.00	8.00
	<u>100.00</u>	<u>100.00</u>
Sulphur	0.549	0.522

At one point on Beech Fork a parting of twelve inches was noted. The bed was formerly opened on Laurel and Rand Forks at the creek bed, same average thickness without parting. The third bed of the section is at the horizon of the McHenry and the Peach Orchard bed and is the noted Ten-foot bed, to see which many have made pilgrimages to this region. There is at this level a large body of coal, but so interstratified with shale as to make it the least valuable, perhaps, of the coals of this locality.

The section of the bed at elevation 890, Scaffold Lick Fork, is as follows:

Slate roof to sand-rock above.

Coal	1 inch
Shale	2 inches
Coal	18 inches
Shale	8 inches
Coal	12 inches
Shale	4 inches
Coal	1 inch
Shale	12 inches
Coal	17 inches
Clay	1 inch
Coal	18 inches
Clay and coal	4 inches
Coal	8 inches
Shale	4 inches
Coal with $\frac{1}{8}$ -inch clay	6 inches
Shale	1 inch
Coal	24 inches
Total	126 inches

As opened on Beech Fork, at 860, the number of thin slate and clay partings is reduced, but the bed is still made up of coal and slate in too frequent alternations to warrant further development as a basis for mining.

The fourth (Broas, or E.) coal, sixty or seventy feet above the preceding, is the principal bed of the region. It varies from 52 to 85 inches in thickness, without regular partings, as indicated by widely distributed openings.

The following tabular view, representative of more than 40 openings over an area of 20 square miles or more, shows the extension and thickness of this coal as now developed in the region.

Locality.	El. above Tide.	El. above Tide	Bed-section in inches.	
Pigeon Roost Branch of Laurel Fork	950		Roof S	Coal 64
Head of Laurel Fork	955	At branch	Roof S	Coal 66
Middle Fork	985	165	Roof S	O 19, S $1\frac{1}{2}$, C 36
Big Hollow	960	At branch	Roof S	Coal 52
Sand Gap Branch of Middle Fork	975	At branch	Roof S	C 2, S 3, O 20, S $\frac{1}{2}$, C 32
Head of Daniel's Creek, Toppins Coal	955	At branch	Roof S	C 69 to 75
Scaffold Lick Fork	955	At branch	Roof S	O 20, Slaty C 1, C 40

	El. above Tide.	El. above Tide	Bed-section in inches.	
Bearwallow Branch of Scaffold Lick Fork	950	At branch	Roof S	C 52 to 54
Beech Fork	920	At branch	Roof S	22 in. to SS. C 52
Oney Gap Branch of Beech Fork	920	At branch	Roof S	Coal 55
Road Fork of Honey Branch	915	At branch	Roof S	Coal 71
Road Fork	910	At branch	Roof SS	Coal 85
Bearwallow Branch of Daniel's Creek	950	At branch	Roof S	Coal 59
Muddy Lick Branch of Daniel's Creek		At branch	Roof S	Coal 61
Daniel's Creek, $\frac{1}{4}$ mile above Muddy Lick Br.	950	At branch	Roof S	Coal 72

It will be observed that the bed is quite persistent as a thick coal, seldom showing a parting, over a great area—20 square miles or more. It is practically limited to the Rockcastle-Daniel's Creek region and parts of adjoining drainage. So far as observed, there are no faults in the region, the beds having an uninterrupted moderate dip northwestwardly.

Some of the openings referred to above were driven under roof 100 feet or more as early as 1882—as then noted by the Survey—and the coal then thrown out now appears, after the weathering of more than 20 years, nearly as bright and firm, and it burns as freely, as when stocked on the hillside.

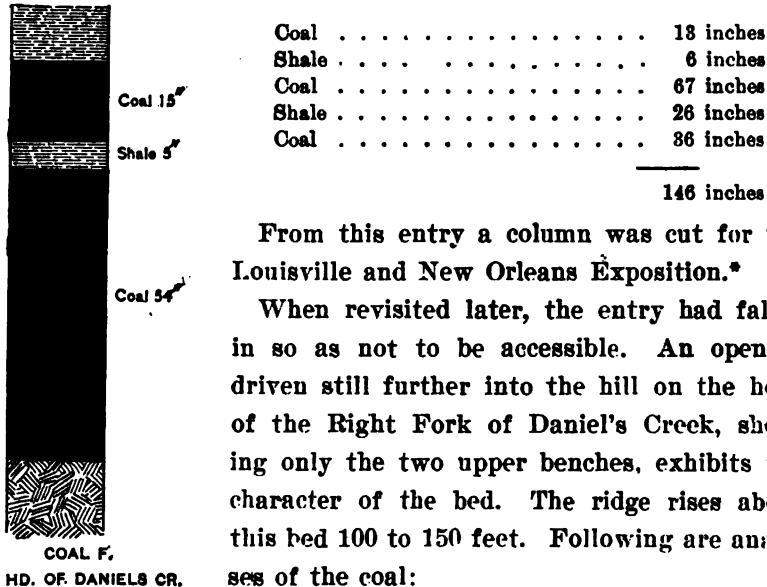
The chemical composition of this coal is shown, in part, by the following analyses made for the Survey; samples taken from near the outcrop:

Locality.	El. above Tide.	Thick. In.	Moist- ure.	Vol. Com. Matter.	Fixed Car.	Ash	Sul.
Big Hollow Br.	960	52	3.08	27.70	60.40	8.80	0.480
Honey Branch,	915	71	4.20	27.40	58.70	8.70	0.808
Road Fork . .	910	85	3.29	39.46	47.53	9.72	0.780

This coal occurs in the interval in which coals 4, 5 and 6 of the Boyd and Lawrence sections are found. The 4-foot coal of the Whitehouse region, 55 feet below the 8-foot bed (No. 8), falls in the place of coal 7, which is absent or not opened in this region. Coal 4, when present, is in closer relations to the Peach Orchard seam. Coal 6 has not been found to extend southward beyond the limit of the Ferriferous Limestone of the General Section, to which reference has been frequently made. The "Broas block

coal" would, therefore, appear, in terms of that general order of beds, to represent Coal 5. This identity could not in any way be based on the character of the bed,, which is quite unlike Coal 5, as described in adjoining regions. The bare statement of the terms on which such an equivalency is suggested is itself interesting as involving striking changes in sequences of beds, and it will be noticed that, while the rocks of the Coal Measures above the Conglomerate formation increase in thickness, as a whole, south-eastward, it appears that that part of the series which includes Coals 5, 6 and 7 decreases in thickness, and disappears as a characteristic part of the General Section.

About 175 feet higher up in the series, the equivalent of the Whitehouse seam is at its full thickness, in good quality, near the level of Bear Wallow Gap. At the head of Scaffold Lick an entry was driven nearly 100 feet, showing the following bed-section:



From this entry a column was cut for the Louisville and New Orleans Exposition.*

When revisited later, the entry had fallen in so as not to be accessible. An opening driven still further into the hill on the head of the Right Fork of Daniel's Creek, showing only the two upper benches, exhibits the character of the bed. The ridge rises above this bed 100 to 150 feet. Following are analyses of the coal:

*This with many other columns obtained at considerable cost from the Big Sandy, Licking, Kentucky and Cumberland River Valleys, a most valuable exhibit, prepared with special reference to Expositions in which Kentucky would be specially interested, was left as a part of the wreckage at the close of the New Orleans Exposition, the exhibit having been left in charge of a Commission which had no conception of the great value of the collection.

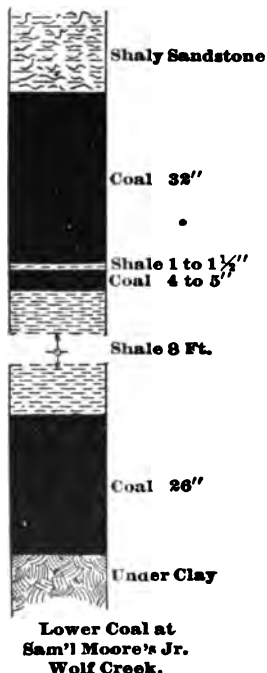
Analyses of Coal F., Head of Daniels Creek.

	Upper 15 in.	Lower 54 in.
Moisture	4.00	4.45
Volatile combustible matter	28.78	28.32
Fixed carbon	58.54	58.42
Ash	8.68	8.80
Total	100.00	100.00
Sulphur	0.494	0.885

This coal was formerly opened on Dick's Creek, where it is said to show a layer of cannel coal. It occurs at the base of a succession of massive, coarse sandrocks which weather into the "rock castles" and jagged ledges and cliffs of the hill tops of this and adjoining regions.

The Region of the Head of Wolf Creek.

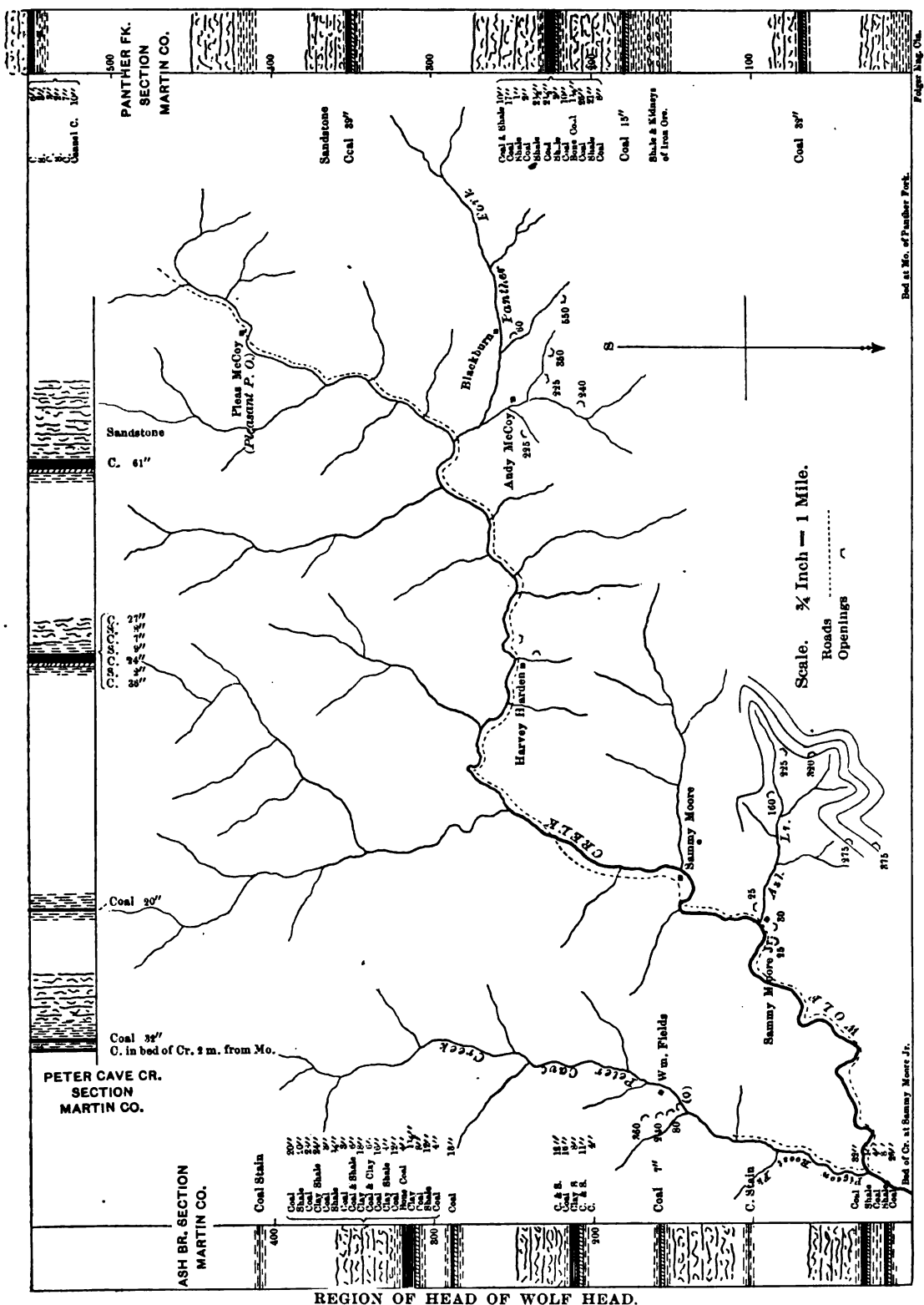
The section of Panther fork of Wolf Creek is drawn from openings made by Mr. Jas. Ira Proffitt, field assistant of the Survey, as were most of the sections originally prepared for this report. The noticeable feature of this section and that of Ash Branch is the distribution of coals in the lower portion. The



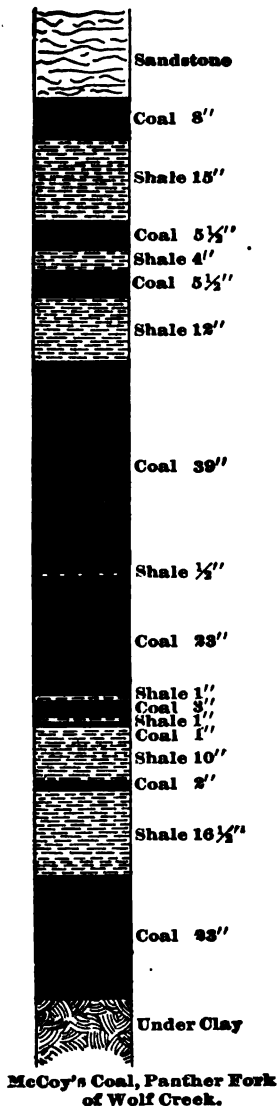
Warfield Coal No. 1, has its probable representative in the two beds at the base of the Ash Branch and also the Peter Cave Creek section. At the former place the beds show a bright hard coal with bed-section as in the cut. The analysis of the upper bed shows an unexpected percentage of ash.

Moisture	2.20
Volatile comb. matter	32.80
Fixed carbon	48.00
Ash	17.00
	100.00
Sulphur	1.813

At Harvey Hardin's this bed shows at the roadside 42 inches of coal excluding 3 to 4 inches of parting at 18 inches from the top of the bed. The openings at 225 and 240 feet



REGION OF HEAD OF WOLF HEAD.



above the mouth of Panther Fork, and that at 275 and 320 on Ash Branch, as well as that at 240 on Peter Cave Creek, expose the "D." bed of the head of Rockcastle Creek—the Peach Orchard seam. The dip in the first two localities is approximately shown by the figures. It should be noted that an error in the Ash Branch section, from failure to correct heights by the dip, makes the interval from Coal No. 1 to this bed about 50 feet too great.

The opening at 240 feet on McCoy's Branch of Panther Fork shows a large body of coal available for mining, as in the accompanying detailed section. The measurements in the vertical section of the locality were taken from an opening made opposite Andy McCoy's house; those of the bed-section from the 240-foot level represent the coal three-quarters of a mile up the McCoy Fork. Few samples for analysis were taken for this region on account of the excessive rains which prevailed almost incessantly during the concluding week of work, making it impossible to obtain clean samples from the bench excavations made. The most important coal of the region is that at an elevation of 350 feet on Panther, 360 on Peter Cave, and represented by the partial exposure of coal at 375 feet on Ash Branch. This is the E. Coal, or

"Broas seam," of the region developed by Mr. R. M. Broas. The opening on Peter Cave was visited after parties interested in the locality had driven an entry well under rock roof, and it was found that the bed maintained its thickness—61 inches of excel-

lent block coal. The opening on Panther Fork shows 39 inches; full thickness probably not reached. Two hundred feet higher up, the Richardson coal is found under a massive sandrock, with cannel coal at the bottom of the bed. The whole bed is decreased in thickness to 31 inches. Most of the main ridges of the region rise above the horizon of this coal and of others still above as shown by the coal stains.

Brushy Fork and John's Creek Region.

This region was worked up by Field Assistant C. N. Brown, then Professor of Civil Engineering in the University of Ohio, and since deceased. The difficulty of obtaining laborers in the crop-growing season prevented a full development of beds in the time allotted, but enough is shown to indicate the character of the economic section. This part of John's Creek Valley shows a decreased thickness of coal-beds, or an increased number of clay and shale partings in some of the coals as represented by the two localities where sections were attempted. Later work for private parties, under the direction of Edward V. D'Invilliers, geologist and mining engineer, also shows the region to be one of transition in which coal-beds are of uncertain value and equivalency. The equivalency of beds at the mouth of Brushy Fork, on Kit Narrow Branch, is not very clearly shown. The shales accompanying Coal No. 1 appear at the base of the hills forming the "Dug Point," near the mouth of Brushy; but the coal is not exposed in recognizable character. A stain appears where the road crosses this point, apparently a thin bed and also 18 inches of coal is exposed below in the branch under a sandstone ledge. The characteristic yellowish calcareous concretions of this part of the series may be seen at points along John's Creek, Brushy Fork and Buffalo Creek; and at the top of the shales exposed in considerable thickness above the main drainage of the region, a fossiliferous band may be traced. At the 400-foot level above the branch what will probably prove to be a good coal, showing at the outcrop 45 inches without parting, was opened, but not



driven to solid coal. In addition to the 45 inches, the exposure shows at the bottom of the bed bituminous shale $1\frac{1}{2}$ inch and 2 inches of coal. The elevation above Brushy is nearly 500 feet. A prominent ledge of coarse sandstone terraces the hills above, as is found over the Rockcastle Creek upper coal; but also as noted at lower levels in some localities. The Little Brushy Creek section begins near the level of the main John's Creek with the No. 1 coal (the equivalent of the Mares Creek and the Laynesville seam, previously reported on), 15 feet up from the Little Brushy Creek at Mr. May's. It has 41 inches of good coal available for mining, the remainder being too much separated with clay shale layers. The next coal above, as in the Laynesville region and in some of the preceding sections, is part cannel and has a thickness which in the not very remote future will be deemed available for mining. The coal at the 235-foot level is of little value. The Leslie iron ore bed found on Caney Creek is between this and the preceding, the rocks being nearly horizontal in this region. This ore shows a thickness, as exposed in the points along Caney Creek, of about 4 feet of limonite. It shows the following composition by analysis:

Iron peroxide	58.835
Alumina	16.627
Lime carbonate	1.200
Magnesia carbonate	0.605
Phosphoric acid	2.178
Silica	4.600
Water, loss, etc.	15.955
Total	100.00
Metallie iron	41.186

The extent of this deposit is not known. Assistant Brown was requested by the owner of the land not to make further investigation there, a request which was complied with as a matter of course. Deposits somewhat like this have been noted at widely distributed points in eastern Kentucky at about this geological horizon. One on Cane Branch of Layne's branch of Beaver Creek, west of the Levisa Fork of the Big Sandy river may very properly be mentioned in this connection. The thickness exposed is about 18 inches of ore

with nearly 39 per cent. of metallic iron. Following is an analysis of it:

Iron peroxide	55.526
Alumina	10.568
Lime carbonate	12.100
Magnesia carbonate	2.497
Phosphoric acid	2.046
Silica	5.000
Water, loss, etc.	12.263
Total	100.00
Metallic iron	38.888

Probably no bed having a considerable thickness of ore will be found continuous over large areas at this geological level, though that similar deposits may exist at points where it has escaped notice is quite probable in so extensive a territory. The relation of this ore to the block ores of the Hanging Rock district is not so clearly indicated as to be referred to any of them, though it is not unlikely that it marks the place of one of these beds as the "Little Block" ore above Coal 3, and at the horizon of the pockets of cannel coal which has been designated Coal No. 4 or the "Rough Block" ore below Coal 3. An ore bed at the head of Clark's branch of Buffalo Creek in this region and across on the head of Fuller Branch, is presumably at the horizon of the bituminous limestone and shale of the Little Brushy section. It is a stratified bed 28 inches thick, and while richer in iron than the Leslie ore it is especially adapted by fineness of its constituent particles and by its deep Indian red color, to use as a paint pigment. An analysis of this ore gives the following:

Iron peroxide	70.423
Alumina	9.588
Lime carbonate	0.500
Magnesia carbonate	0.227
Phosphoric acid	1.279
Silica	1.200
Water, loss, etc.	16.888
	100.000
Metallic iron	49.296

Of the three coals above this level, only one was opened, as the

land at the head of Little Brushy was found to belong to parties already referred to as objecting to such development, doubtless from some misunderstanding or misrepresentation of the purpose of work. The "6-foot" bed at the 525-foot level has the bed-section as here given with analysis of the coal:

		Moisture	8.80
		Volatile combustible matter	28.00
		Fixed carbon	57.20
		Ash	11.00
			100.00
Coal	43"	Sulphur	0.590

Twenty inches from the top of the bed, 2 inches of soft, somewhat earthy coal is included in the measurement. Below this coal along the spur between Leslie and Little Brushy Creek, an "Anvil Rock," which might be called "Toad Stool Rock" from its form, stands out by itself about 13 feet high, the top about as broad, supported by a small doubly conical pillar. Still further down the point the great thickness of sandstone shown in the section is exposed in ledges, jagged masses of cliff pongs; one of the latter being so narrow as to have large openings weathered through from side to side. Four hundred feet below the Buffalo Creek iron ore, over a coal opened at Mr. Clark's towards the head of Clark's Branch, and near the bed of the creek, the dark roof shale has imbedded molluscan fossils in much greater abundance than is found in the Coal Measure rocks of Eastern Kentucky other than limestone, except in a few widely separated localities. Species of *Bellerophon* and *Nautilus* were noted along with gasteropods, lamellibranchs, and brachiopod forms, the latter chiefly *Productus* and *Chonetes*. From the character of the shale, great care will be required in the collection of these fossil forms. This bed is probably the same as that previously mentioned, near the base of the section, the dip of

Leslie's Coal	
Hd. Little Brushy Cr.	

the beds being down Buffalo Creek. The thickness of the coal-bed here is 26 inches, including 4 inches of shale.

The Tug Fork and Big Creek Region.

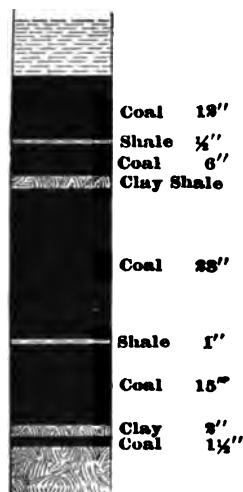
The section on the Tug Fork at James Deskins' shows most of the coals of the Tug Fork Valley.

The lower bed, 40 feet above low water, has from 60 to 72 inches of coal with three and four shale partings aggregating 27 to 30 inches. Seventy-five feet higher is a bed which shows no workable benches and may be omitted from the number of workable beds here. The second and third prominent beds show respectively, 61 inches of good coal with $3\frac{1}{2}$ inches of parting, and 49 inches of coal with 2-inch parting.

The fourth coal is the most promising bed. As more recently opened by the Borderland Coal Company, it shows 74 to 78 inches of good block coal, under sandstone roof, with 1 inch of slate at about 33 inches from the bottom of the bed. The second and third coals also show less of partings in recent openings at Borderland. Another bed of considerable thickness is reported on the next bench 60 feet above, or near the 600-foot level; and near the top of the ridge is a thick bed of alternating coal and slate partings, as in the section. The Borderland Coal Co.'s entries are in the 4th coal of this section from the steep point between Frog Pond Branch and Hurricane Branch. The mine is connected by aerial bucket-tramway across Tug Fork to the Norfolk & Western Railway.

The relation of the coals of this section to the beds of the Broas region is not clearly indicated by either the serial order or the character of the beds. The Borderland bed is said to be the Thacker coal of West Virginia. Masses of cliff-forming sandrock are prominent towards the tops of the ridges, as noted in adjoining regions, over the Whitehouse "8-foot" seam.





3rd. Coal at Deskings'
Tug Fork.

A cut of the bed-section of the 3d coal in this locality and an analysis of sample by the chemist of the Survey, and also an analysis made for the company by A. A. Phleger, chemist of Virginia Coal & Coke Co. are here given. The methods of taking the samples were doubtless not the same.

	Survey.	Phleger.
Water	1.40	1.86
Volatile comb. matter	86.60	41.78
Fixed carbon	55.80	54.44
Ash	6.20	2.42
	<u>100.00</u>	<u>100.00</u>
Sulphur		2.280

An analysis of the bed at the 400-foot level was made for the Borderland Coal Company, from sample supplied by them, by A. A. Phleger. It is as follows:

Moisture	1.02
Volatile combustible matter	40.80
Fixed carbon	51.46
Ash	7.00
	<u>99.78</u>

An analysis for the company of the Borderland seam is as follows:

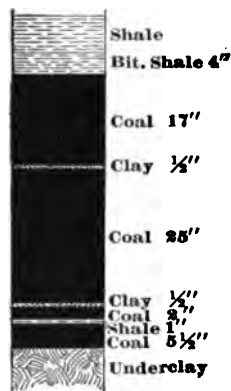
Shale	Moisture	.986
Coal 10"	Volatile comb. matter,	85.260
Shale 9 1/4"	Fixed carbon	60.437
	Ash	2.774
		<u>99.457</u>

Cannel Coal 23"	Sulphur	0.548
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The bed-section of the "Cannel Coal" of Turkey Creek and an analysis of the cannel bench are as follows:

Coal 21"	Moisture	2.10
	Volatile combustible matter	44.70
	Fixed carbon	45.50
	Ash	7.70
		<u>100.00</u>
Under Clay	Sulphur	1.606

Williamson's Cannel Coal
Turkey Cr.



Deskins' Coal
400' above Tug Fork.

The order of coals below is not shown by the local exposures noted below the canal seam.



The Bevins coal, 40 and 55 feet above the creek in the Big Creek Section, is probably at the 175-foot level in the Deskins locality. It shows some variation in bed-section up Big Creek. The following cut represents the maximum thickness as noted where the sample for analysis (following) was obtained.

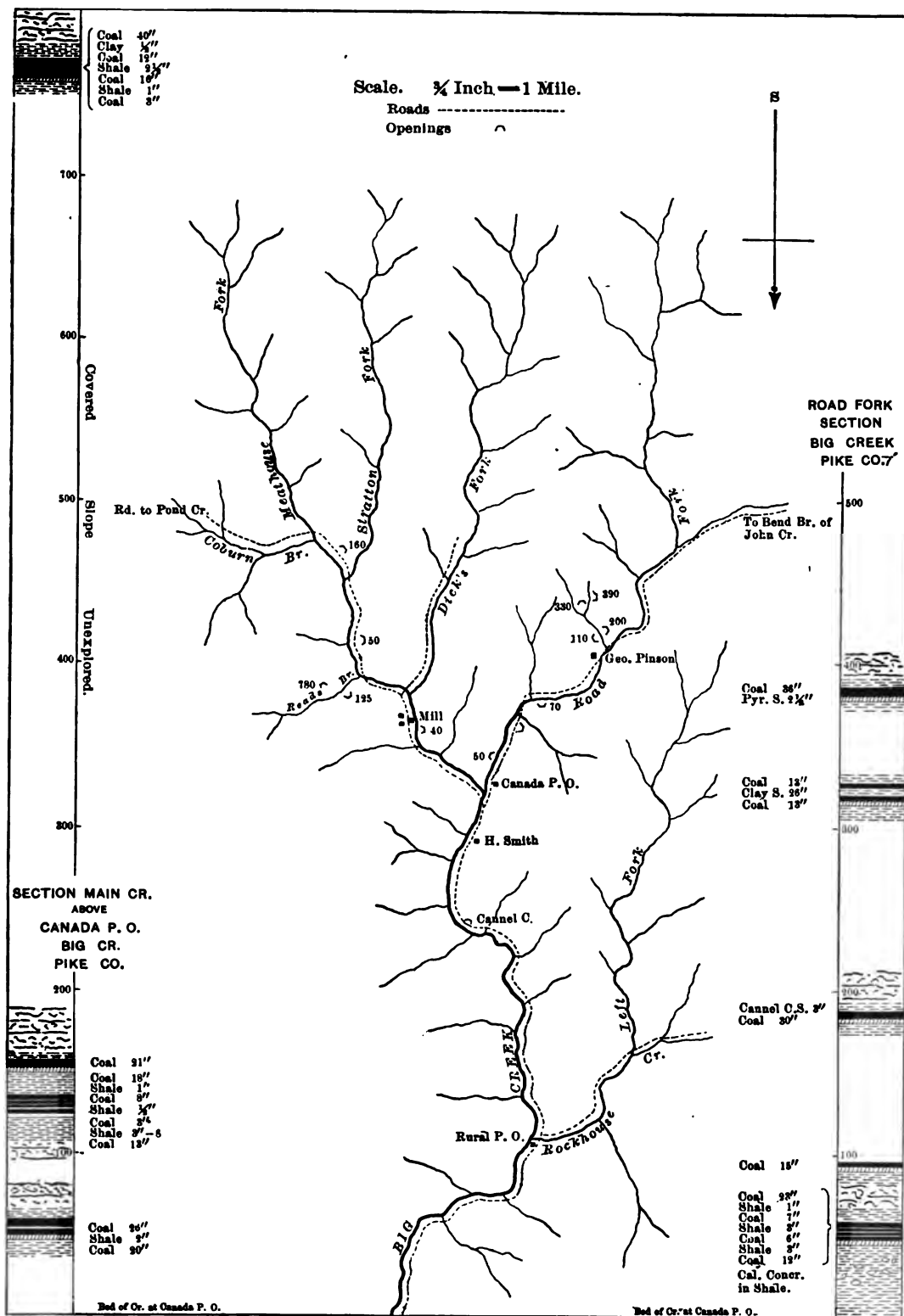
The percentage composition shows a good coal.

Moisture	2.60
Volatile combustible matter	84.80
Fixed carbon	57.80
Ash	5.80
	100.00
Sulphur	0.604

The coals higher up in the hill were opened to rock roof, showing outcrop bed-sections as given in the Bevins section. The Rock-house Fork of Big Creek joins the main creek at this point, heading by its several forks against Pigeon Roost Fork of Wolf Creek, and Brushy Creek of John's Creek valley.

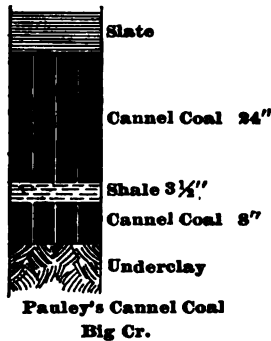
Upper Big Creek Region.

Going from Rural postoffice up Big Creek, a cannel coal may be seen fifteen feet above the creek which may be called Pauley's cannel, as in other instances, from the name of the owner of the land on which it is exposed. The place of this coal in a general section for Big Creek is a matter of doubt. The rocks of the region dip down the creek with local changes which make it uncertain whether the cannel represents the lower Bevins coal of the preceding locality or a bed below. If, as seems quite probable, the latter supposition is correct, this deposit is not at a level elsewhere known as





a cannel coal horizon. The bed is shown in detail in the accompanying cut, and the quality of the coal by the following analysis:



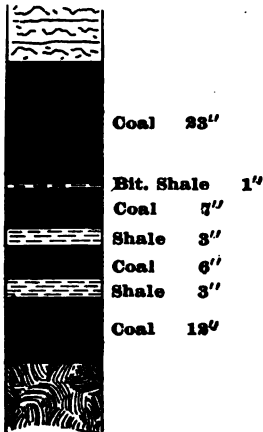
Moisture.	1.40
Volatile combustible matter	42.00
Fixed carbon	46.40
Ash.	10.20

100.00

Sulphur	1.098
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The coals of the section were opened on the Road Fork above Canada postoffice for half the height of the hills of the region, and on the Left Fork, or main creek, the section is supplemented by some openings

for local use and by an opening under a cliff near the top of the hill. The dip of the rocks exposed on the Road Fork is about 20 feet to the mile northward, as shown at 50 and 70-foot levels of the lower coal. The bed-section here given is as at the upper opening on S. R. Pauley's land. The whole bed was sampled for analysis:



Moisture.	1.60
Volatile combustible matter	35.80
Fixed carbon	58.00
Ash	4.60

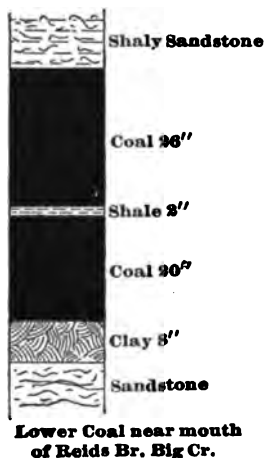
100.00

Sulphur	0.767
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The coal found at the 390-foot level on the branch at Rev. Geo. Pinson's may be regarded as the upper seam at Jas. Bevins' of the preceding locality. The second coal

in the section, at the left margin of the page map of this region, appears in general character and surroundings to be the same as the lower seam of the Road Branch section; though without an abrupt change in the dip, or a dislocation of the strata of which no conclusive evidence was noted, the bed at 50 feet above the

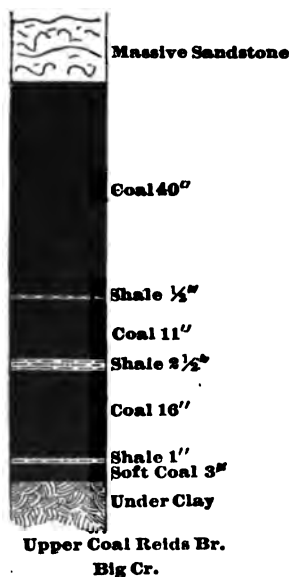
forks of Big Creek and near the bed of the creek where opened on the Left Fork appears to occupy the place of that seam. The bed



at the 125 foot level and one at 160 feet, $1\frac{1}{2}$ miles up the creek at a steam mill, appears to be the same. The measurements given in the section for the Left Fork or Main creek were taken at the latter point, the former having fallen in so as to be partly covered at the time. The coal at the bed of the creek above Reid's Branch is shown in detail in the accompanying cut. Whatever its place in the general section of the region, it is here equal in value to the Lower Road Fork coal, which in physical character it resembles.

The seam at the 780-foot level on Reid's Branch is also an excellent coal.

The details of the bed are shown in the accompanying cut. Analysis given is of a sample which was taken near the outcrop:



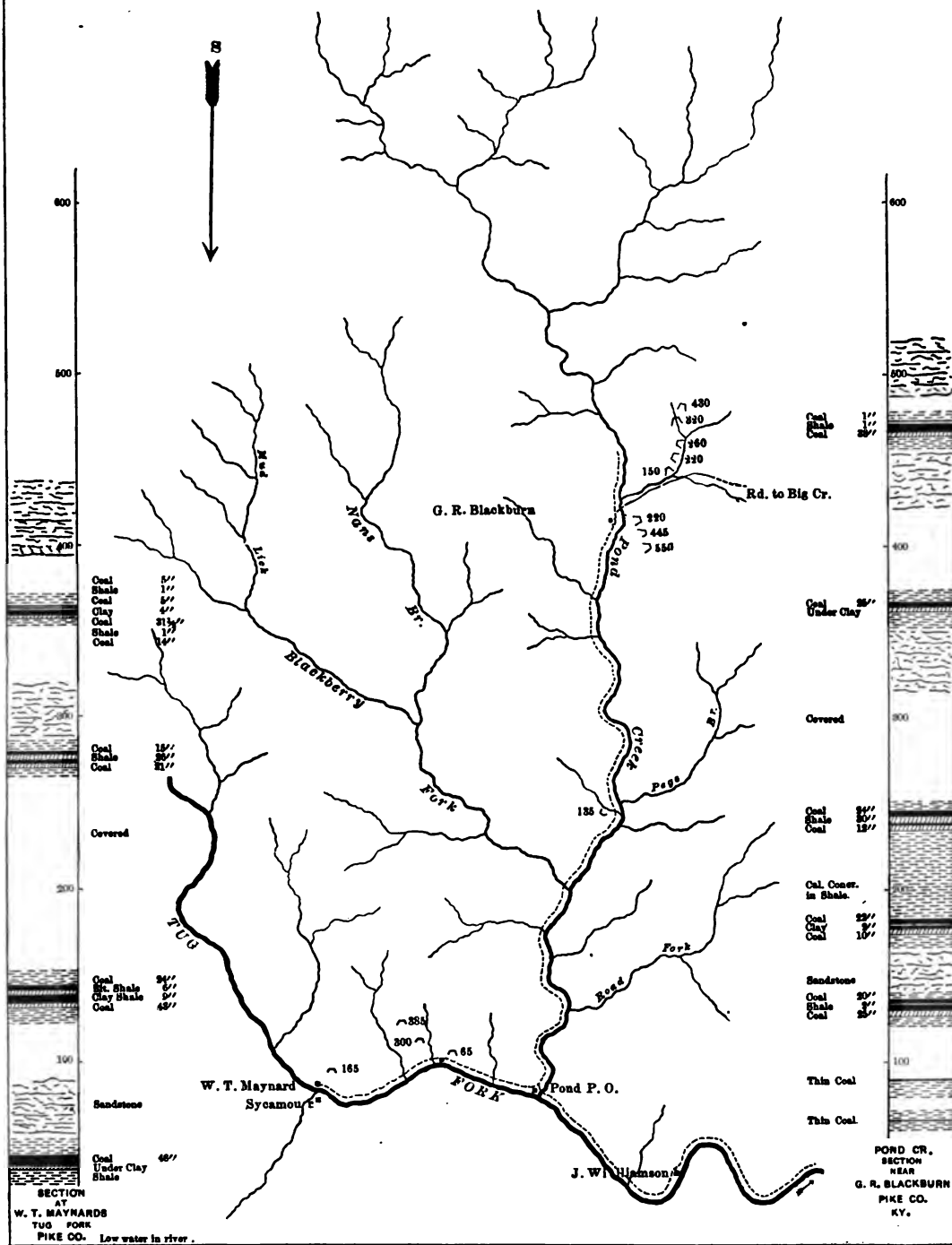
Moisture	1.20
Volatile combustible matter	83.20
Fixed carbon	61.00
Ash	4.60

	100.00
Sulphur	0.681

The appearance of this bed is that of a good coking coal, but no tests have been made to determine its value as a coking seam.

Roads

Openings >



TUG FORK AND POND CREEK.

Folger Eng. Ctn.



Tug Fork and Pond Creek Region.



The Pond Creek section was made about 7 miles up the main stream at G. R. Blackburn's. All the coal beds were opened for two-thirds of the height of the hills in this region, showing the order of the coal beds to be as in the previous locality, with the intervals varying somewhat both in the thickness and character of the rocks. The lower coal is like the lower bed over the ridge, on Big Creek above the forks, in bed-section and in quality. The same bed has been opened opposite the mouth of Peg's branch, increased in thickness to 6 feet or more, with a parting of 5 inches. The opening, at the time visited, had so fallen in as to prevent accurate measurement.

The upper bed of the section is also a good coal. The dip here is down the creek, about 35



feet to the mile. The elevations at coal openings are local.



The section at Maynard's, on Tug Fork, shows increased thickness of coal beds. The lower bed, opened at the school house for fuel, is without parting as in the engraved illustration herewith. It is, however, readily traced with the northward dip of the beds to the level of the lower Blackburn coal, which it resembles in physical character.

The second coal of this locality is also a valuable bed. The features of the bed are shown in the accompanying cut. A sample for analysis was taken from the whole seam. Following is the analysis:



Second Coal at
W. T. Maynard's
Tug Fork.

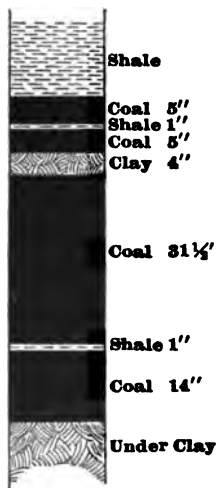
Analysis of Second Coal at Maynard's.

Moisture	2.00
Volatile combustible matter	32.00
Fixed carbon	60.00
Ash	6.00
	100.00
Sulphur	0.577

The 4th coal is here a splint or semi-cannel, with a thickness of 46 inches, from which only one inch must be excluded. The *whole* bed is 61 inches thick, including 6 inches of slate. The percentage of sulphur indicated by analysis detracts somewhat from its value as a steam coal.

Analysis of Fourth Coal at Maynard's.

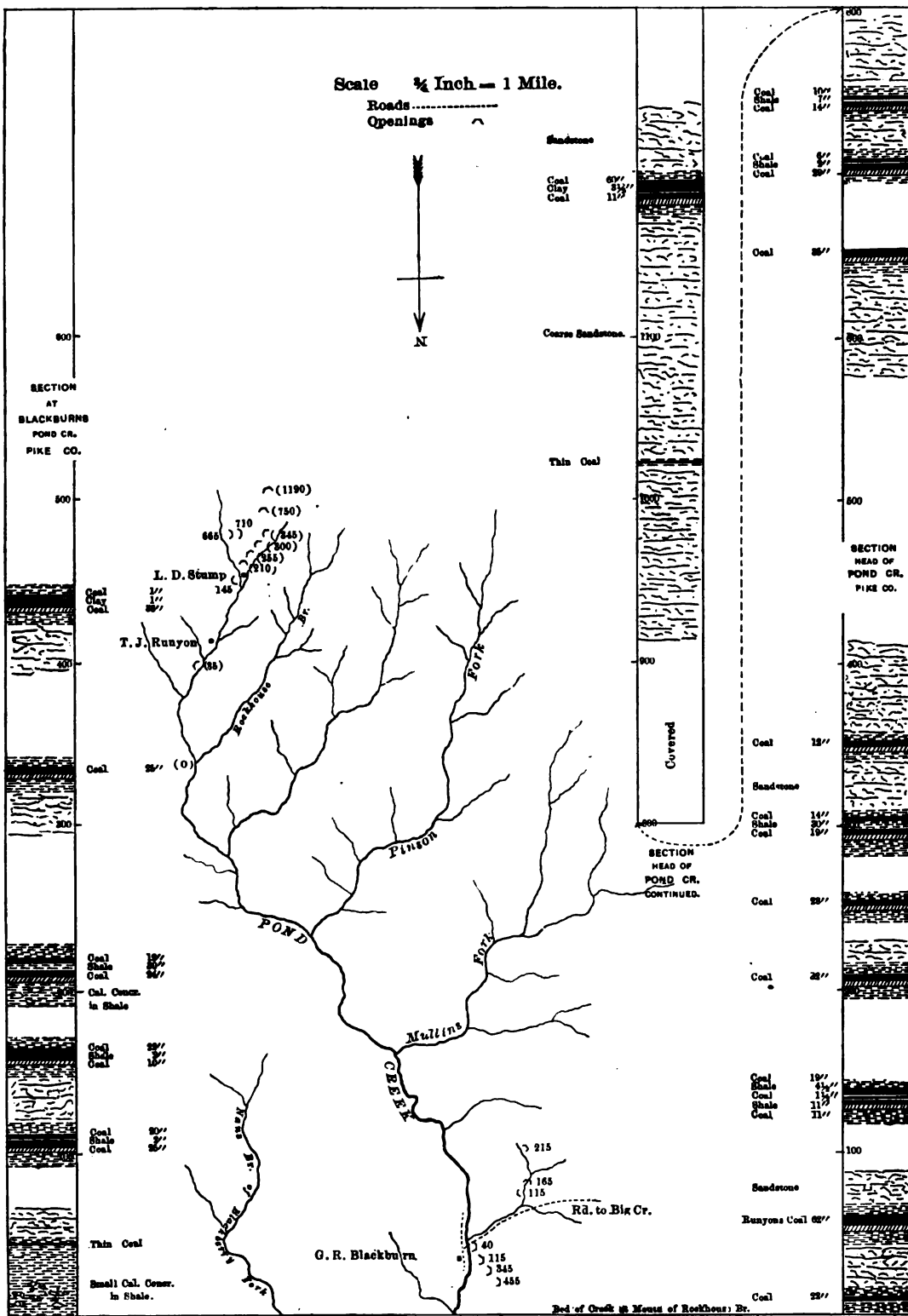
Moisture	1.20
Volatile combustible matter	38.40
Fixed carbon	55.00
Ash	5.40
	100.00
Sulphur	2.527



Fourth Coal
at W. T. Maynard's
Tug Fork.

The lower coal appears to be the most promising bed for this region and of the preceding; as also of that at the head of Pond Creek, and it is to be regretted that samples for analysis were not taken at the time when visited, though unfavorable, instead of deferring until preliminary coking tests could also be made. The time has not been found for the further study of this and other beds which the character of coal warrants.* See analysis of Runyan's coal of the following region representing this bed.

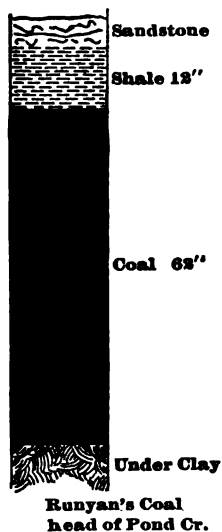
*It was hoped that Prof. Crandall would be able to report fully on all the coals of this region, but circumstances have prevented his doing so. More complete details will be covered when preparation of county reports is undertaken—C. J. N.



REGION HEAD OF POND CREEK.

Region Head of Pond Creek.

At the head of Pond Creek, the hills rise to a height which affords a view of the surrounding country such as can be obtained at few points in the region at large. This point was selected as most likely to give a key to the coals high up in the measures north of Pine Mountain, as was also the Marrowbone Creek and Flat Woods region in the southwestern part of Pike county. The section at Blackburn's is repeated for comparison, the elevations being from the creek at his house. The lower coal of the section at the head of the creek appears to be a continuation of the Blackburn seam and the lower bed at Maynard's. This presumes a dip to northward of 30 feet or more to the mile. The opening made by Mr. T. J. Runyan at the mill $\frac{1}{4}$ of a mile below his house was driven far enough to be free from infiltrated clay. No regular partings appear in the bed as drawn; but some very thin interrupted bands of fibrous coal (mineral charcoal, or mother coal),



were noted, and a band 16 inches from the top, 4 inches thick, evidently having an increased percentage of ash. Sample was, however, taken from whole face of bed:

Moisture	1.40
Volatile combustible matter	27.20
Fixed carbon	65.00
Ash	6.40

100.00

Sulphur 0.194

The coal closely resembles the coking seam to be described in many localities southward, both in appearance and chemical composition. The number and order of beds above, however, does not make a comparison of horizons conclusive as to equivalency of beds here and in the central part of the Elkhorn field. The remainder of the lower half of

the upper Pond Creek section is important in this connection chiefly by way of comparison with those of adjacent regions, and needs no further description than is given in the section. The 2d coal is opened opposite L. D. Stump's house. The upper part of the section shows the distribution of coal beds in that portion of the coal measures of which little is known north of the Pine

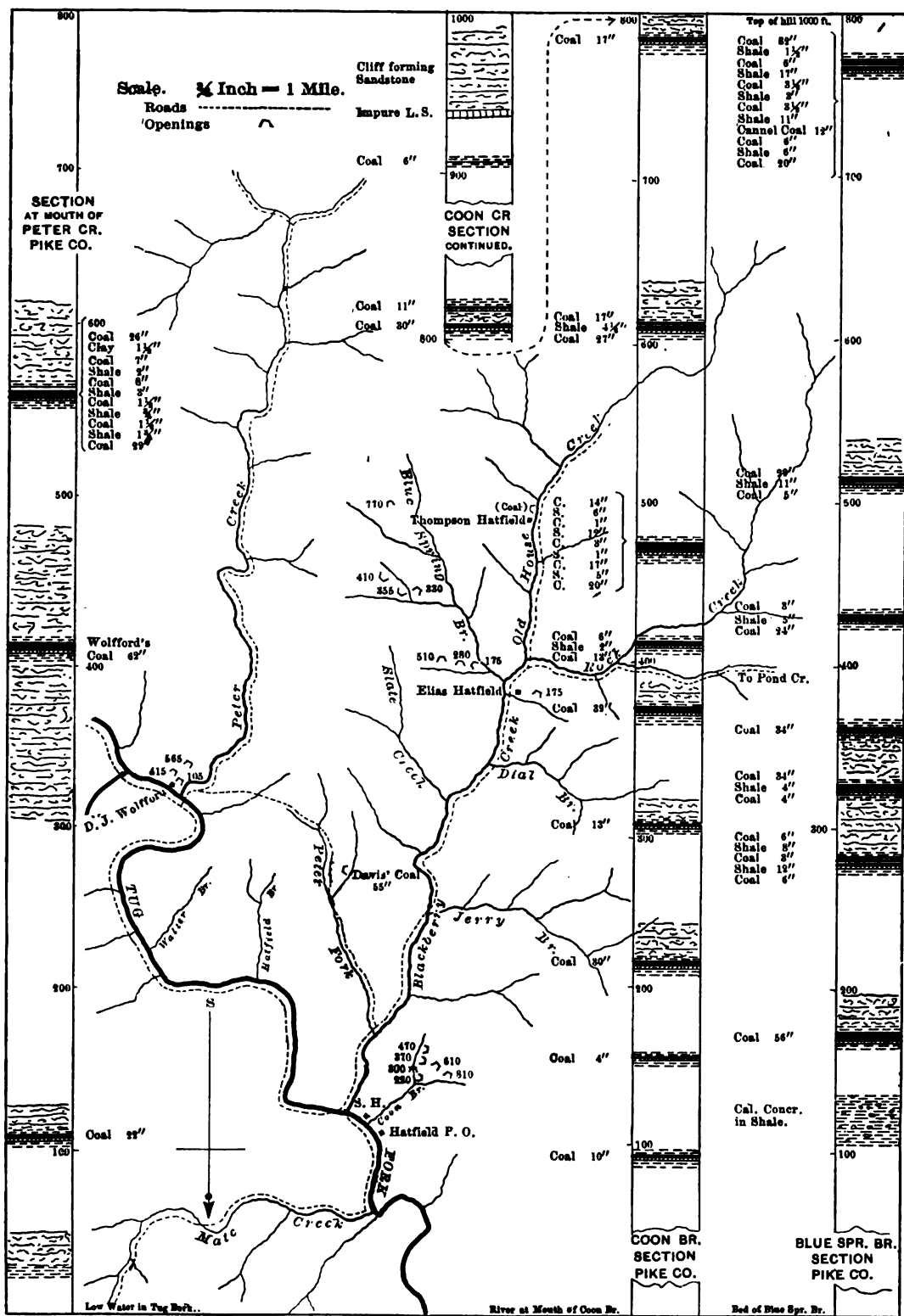


Stump's Coal
head of Pond Cr.

Mountain; this portion of the series being, for the most part, either largely or entirely removed by the eroding agencies which have carved out the present relief and drainage features of the country.

The coals at the 650 and 700-foot levels are found at a few points further west and south. Above the group of beds here represented, coarse, hard sandstone is exposed for most of the interval to the great coal at the 1200-foot level. So far as may be inferred from an opening driven to determine the thickness only, this bed is of good quality. The question of the place of this coal in the series of the Appalachian Coalfield may very properly be left, with special discussions of equivalency in this field, for the general report on the Eastern Kentucky Coalfield.* This section may be compared with the Marrowbone section in upper Pike county.

*This is necessarily deferred until the coals in the several parts of the field have been thoroughly studied—bulletins, such as this, being issued meantime to in a measure supply information concerning coals of the various valley regions.—C. J. N.

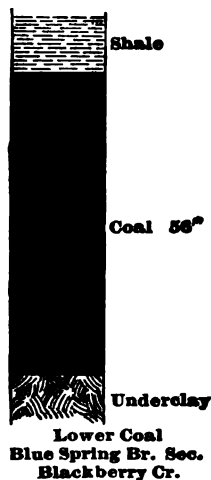


TUG FORK AND BLACKBERRY REGION.



Tug Fork and Blackberry Creek Region.

The openings made in this region carry most of the coals of the preceding sections southward to the region of Peter Creek. The 56-inch coal of the Blue Spring Branch section is the principal bed of the region, being, evidently, the continuation, in this direction, of the Runyan seam of Pond Creek. It is opened in two places, at 175 feet above the main creek at Elias Hatfield's. In the hill west of his house an entry, showing the bed-section, is driven to firm coal, from which a sample for analysis was cut, excluding 4 inches, near the top, of slaty coal. Following is the analysis:



Moisture	2.60
Volatile combustible matter	28.16
Fixed carbon	65.24
Ash	4.00

Sulphur	0.500
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Above Thompson Hatfield's house, on Old House Creek, this bed, as exposed, shows seventy-nine inches. Eighteen inches at the top was too badly weathered and mingled with earth to show its physical character or its composition by analysis. Sample for analysis was cut from the lower 60 inches of the bed, which was firm and nearly free from infiltrated clay. The results of the analysis are as follows:

Moisture	2.90
Volatile combustible matter	28.80
Fixed carbon	65.70
Ash	4.60
	100.00
Sulphur	0.49

On Peter Fork of Blackberry Creek which heads towards the mouth of Peter Creek, this bed is easily recognized in its special character, not excepting the slaty layer at the top.



Davis Coal
Peter Branch of
Blackberry Cr.

Coal 8"	Moisture	1.40
Shaly Coal 3"	Volatile combustible matter	27.40
	Fixed carbon	68.74
	Ash	7.46
Coal 46"		100.00
	Sulphur	0.549

The sample was taken from near the outcrop, but from a face showing little weathering. In the Coon Branch region, this bed is but 30 inches thick, and thicker coals are found higher up.

The 39-inch bed of the Coon Branch section was driven to solid coal and a sample for analysis taken, which follows:

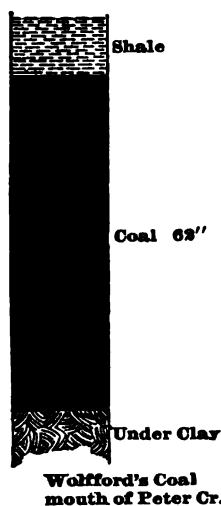
Moisture	1.70
Volatile combustible matter	30.30
Fixed carbon	61.54
Ash	6.46
	100.00
Sulphur	0.521

The hills here rise to the height of 1,000 feet, including nearly 400 feet less of the upper measures, however, than the hills at the head of Pond Creek. Ten coal beds, which may be comparable with beds elsewhere, were opened in this locality, as shown for the Coon Branch locality; but it is more probable that some of them are local, or restricted to the hills which form the water-shed between Pond, Blackberry and Peter creeks, and the head-waters of John's Creek.

The dip down Blackberry is less than in the two preceding regions, being about 20 feet per mile. A greater dip falls across the valley west of north, or down the river valley.

The impure limestone near the top of the hill at the bed of Coon Branch is probably local.

The identity of the principal coal of this region with the Elkhorn coal in the southwest is so clearly indicated by comparison of representative sections, and the character of the bed, that it may be referred to as the coking or Elkhorn coal. At the mouth of Peter Creek, Wolford's coal, high up on the hill, represents the coking seam of the region. The rock strata rise about 50 feet to the mile up Tug Fork from the north of Blackberry Creek, an inclination of beds which brings the upper member of the Conglomerate Measures above drainage southward near the Virginia line. The rise continues for some distance, adding to the prominence of the Conglomerate masses said to be exposed in the "Roughs of Tug." The height of the Davis coal, previously described, above the river is about 400 feet, while the Elias Hatfield coal is about 300 feet, showing that the dip is to the northwestward or, as should be expected, in a general way at right angles with the axis of the uplift extending in line with Pine Mountain from the "Breaks of Sandy" to the "Roughs of Tug." This dip should be borne in mind in tracing the beds from this region to that at the head of Peter and Knox



creeks. The opening of Wolford's coal was not driven to solid coal, and the sample collected for analysis was not, therefore, entirely free from adhering clay—increasing the percentage of ash. Sample for analysis, which follows, was cut from whole face of bed as represented by cut:

Moisture	5.20
Volatile combustible matter	26.00
Fixed carbon	59.70
Ash	9.10

 100.00

Sulphur	0.412
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The excess of hygroscopic moisture, reducing other percentages,

is in consequence of the weathered condition of the coal. At this point, and up Peter Creek, the thickened sandstone ledges both above and below this seam not infrequently project from the hill slope in narrow cliff points which, at a distance, appear like sentinel towers on the mountain side.

Recently* the Pike Collieries Company, Mr. A. R. Paddock, General Manager, located a mining plant at the mouth of Blackberry Creek, one mile above a point opposite Matewan, West Virginia. A tram-railway extends to the mines, which are four miles up the Peter Fork of Blackberry Creek, and 510 feet above the Norfolk & Western Railway grade at the mouth of Blackberry Creek. The coal mined is probably about 130 feet above the Davis coal of Peter Fork. It shows, under black slate roof, as follows:

Roof of black slaty shale.

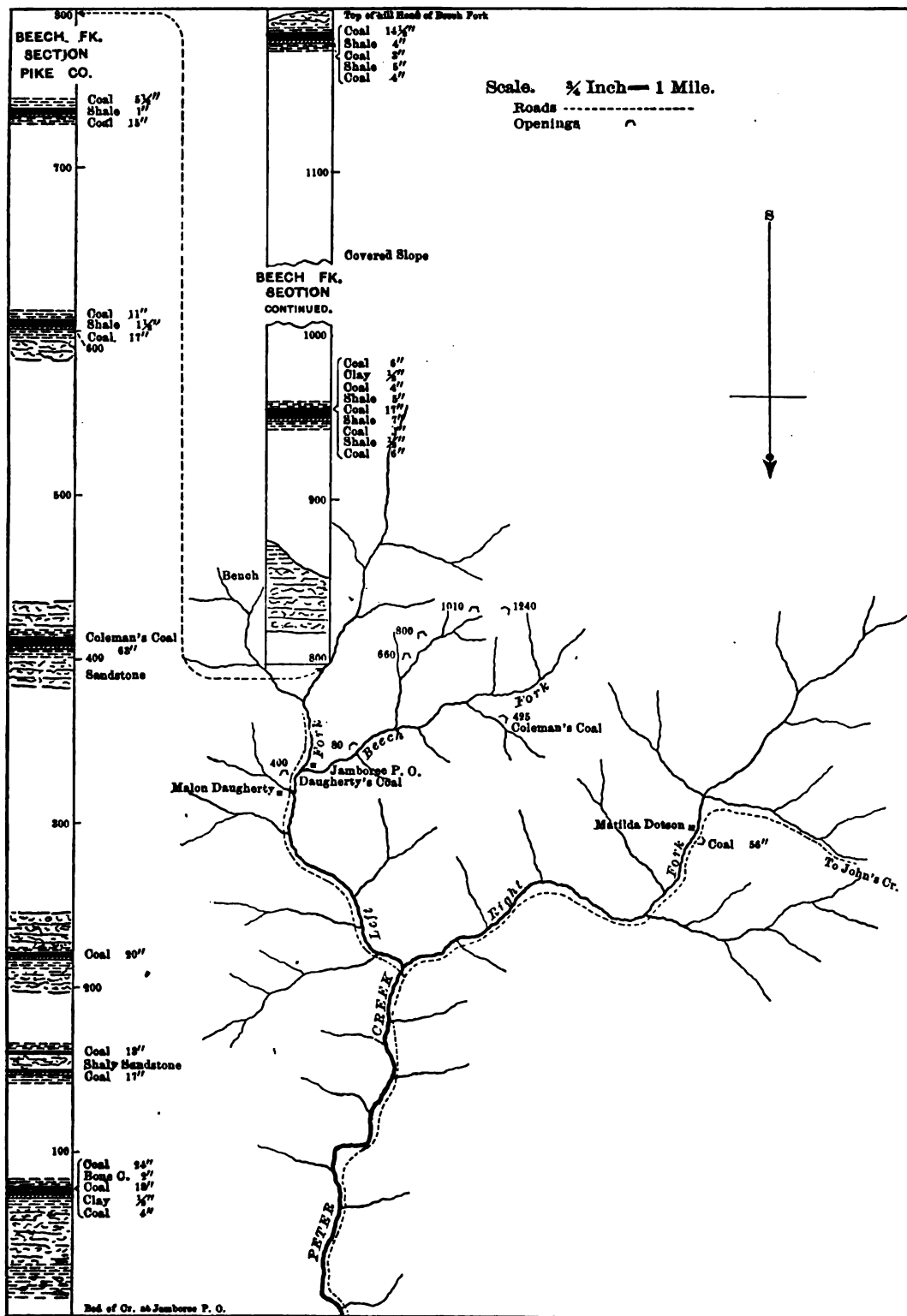
a. Splinty coal	45 inches.
b. Slaty parting	6 "
c. Soft coal	18 "
Total thickness of bed	69 "

This bed is apparently the upper coal of the section at the mouth of Peter Creek. An analysis made for the company shows as follows:

	Splint 45 in.	Whole Bed.
Moisture	0.860	1.02
Volatile combustible matter	36.66	37.11
Fixed carbon	56.22	56.51
Ash	6.26	5.30
	100.00	100.00
Sulphur	0.715	1.114

The Freeburn Coal & Coke Co. are preparing* to mine the Wolford seam one-half mile above the mouth of Peter Creek. The Vulcan Coal Co., under the general management of Mr. A. D. Rice, has opened mines (the Vulcan) two miles above the mouth of Peter Creek. The Vulcan Company also mines the Wolford seam, which

*July, 1906.



HEADWATERS OF PETER CREEK REGION.

Folger Eng. Cln.



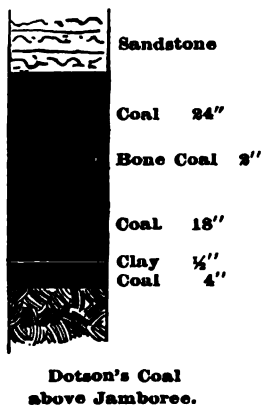
is now known as the Vulcan seam. The thickness of the bed is 67 to 76 inches, including the slaty coal noted at various points 6 to 8 inches near the top of the seam. This slaty portion is rejected as a "parting," when mining the coal. An analysis made for the company is as follows:

Moisture	1.24 per cent.
Volatile combustible matter	29.28
Fixed carbon	64.55
Ash	4.98
	100.00
Sulphur	0.625

Two coal beds were recently opened higher in the hills, at intervals of about 140 and 180 feet—the Glen Alum and Thacker coals of the West Virginia sections. An incline to the first named bed is being built for an outlet for that coal, which is reported as 48 inches or more of good coal. The mines here are connected with the Norfolk & Western Railway at Vulcan Station, by aerial bucket tram.

The Region of the Headwaters of Peter Creek.

At the head of the Left Fork of Peter Creek the ridge reaches a height of 1,200 feet above Tug Fork, including 800 feet of measures above the coking seam in which four of the most prominent



coals are opened. Below the coking coal, opened on the land of J. H. Coleman, several beds appear that represent coals towards the base of the measures above the Conglomerate series. These coal-beds are not constant either in place, thickness or value in the coking coal field. The lower bed, known as Dotson's coal, has a thickness of 48 inches, with two partings, as shown in the engraving. It is a very good fuel coal, as the following analysis shows:

Analysis of Dotson's Coal.

Moisture	0.80
Volatile combustion matters	28.40
Fixed carbon	60.80
Ash	10.00

100.00

Sulphur	0.719
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J. H. Coleman's coal shows the characteristic bed-section of the coking coal of the region in general, including 3 to 4 inches of slaty



Coal 20"

Slaty Coal 3"

Coal 40"

coal hardly noticeable at any place in the region to the casual observer, but containing ash enough to require separation in mining—as high as 28 per cent., as tested at one point. Sample of this coal for analysis excludes the slaty band, but includes 1 inch of bone coal at top of the lower 24 inches, which approaches splint in structure. Following is the analysis:

Moisture	1.80
Volatile combustible matter	26.20
Fixed carbon	65.80
Ash	6.20

100.00

Colemans' Coal
above Jamboree.

Sulphur	0.549
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This coal is faced up in the hill opposite the house of Mahlon Dougherty, on the branch below Jamboree postoffice at the forks of Peter Creek. Here the coal is much weathered, showing a face 89 inches from the floor to the overlying shale, with less than an inch of clay 38 inches from the bottom. If driven to solid coal the thickness would probably be reduced somewhat. The slaty band is not definitely recognizable in the weathered coal. On the Right Fork of the creek, this seam is opened at Mrs. Dotson's, showing 56 inches, with a thin, slaty band near the top. The opening is driven sufficiently to show the character of the coal, which is readily recognized as the coking seam of the region. The height of the bed at Coleman's is about 450 feet above the creek at Jamboree; at Mahlon Dougherty's it is but little

more than 400 feet, and at Mrs. Dotson's on the Right Fork, about 220 feet, showing a strong dip to the northwest as in previous locality. So far as practicable, corrections for the dip are made in the sections.

More recent developments in this region tend to confirm the inference which follows from the notes of the Survey as given, that the principal coal gives to the region great importance as a part of the Elkhorn field of Kentucky. The bed-section of this coal varies, but maintains a workable thickness. On Hurricane Fork of Knox Creek, as measured by Mr. Joseph Sillyman, the following sections are shown. Openings were not driven to solid coal. Thicknesses are in inches:

Shale roof.	1	2	8
Coal	50	47	Weathered coal
Impure coal	14	7	but driven to
Coal	23	18	roof, 69 inches.
	<u>87</u>	<u>67</u>	

On Peter Creek, 370 feet above the creek at the mouth of Big Branch is Frank Phillips' coal; three miles up Peter Creek, at 242 feet, is Chaney's drift, and two miles above Jamboree, on the right side of the valley, is D. J. Dougherty's opening, 423 feet above the creek. Following are the bed-sections at the respective places. Thicknesses in inches:

PHILLIPS ENTRY.	CHANAY ENTRY.	DOUGHERTY ENTRY.
Sandrock roof.	Sandrock	Shale roof.
Coal 41	Coal 66	Coal 21
Impure coal . . . 5½	Slate 2	Slate 4
Coal 25	Coal 6	Coal 26
		Splint coal . . . 33
<u>71½</u>	<u>74</u>	<u>84</u>

The average of four analyses of samples from openings on Knox, Peter, and Fed's creeks, as given by Sillyman, is as follows:

Water	1.620
Volatile matter	82.169
Fixed carbon	58.296
Ash	7.270
Sulphur	0.648
	<u>99.999</u>

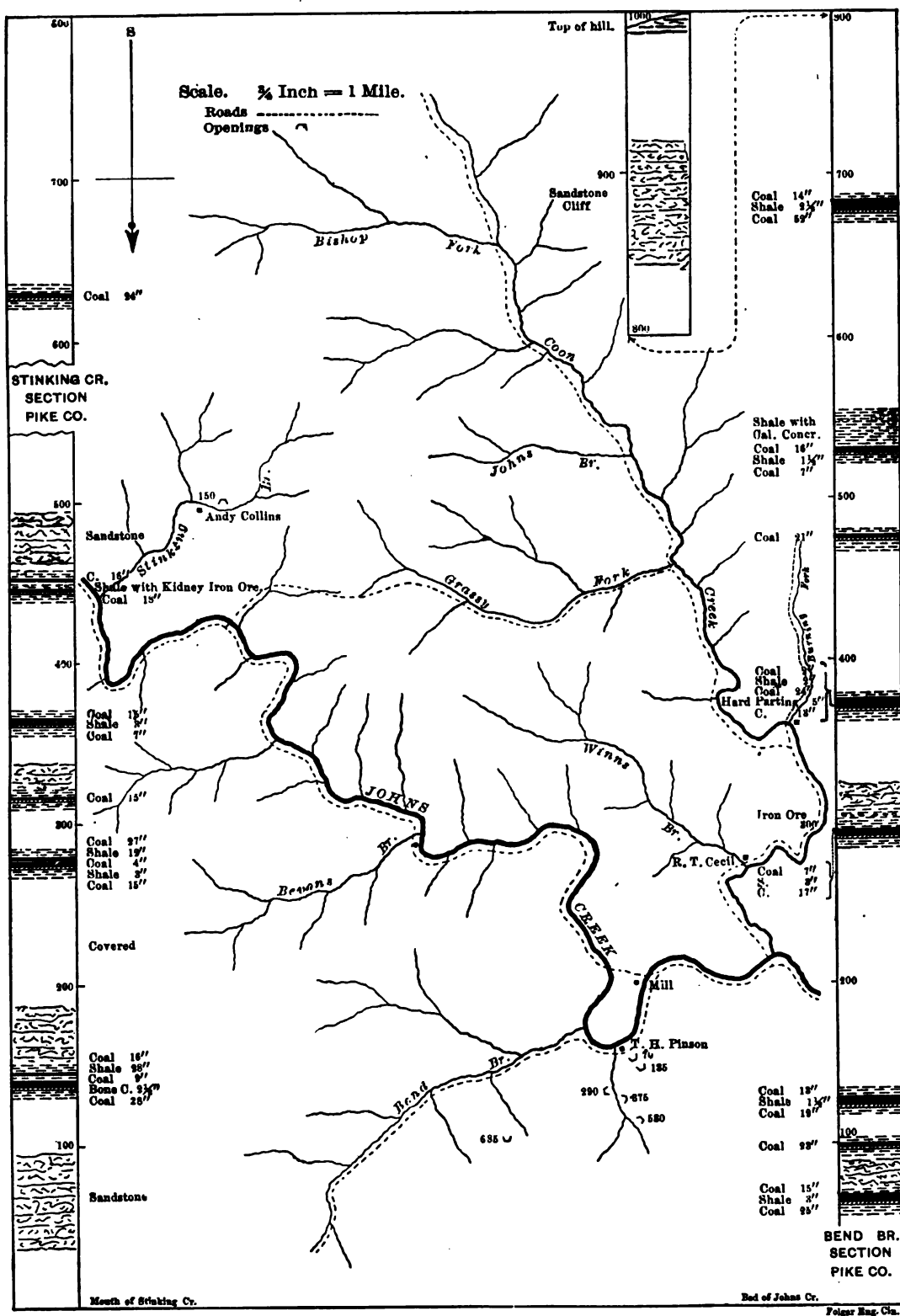
The ash is increased in the eastward extension of this field, as shown by analysis more than by the appearance of the coal, which is bright, with cleavage in small cubes, excepting the splinty layers noticeable here as in the Elkhorn field.

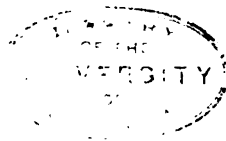
The coal-beds of the headwaters of Peter Creek may be compared with preceding regional sections and with the following with respect to vertical distribution and equivalency of beds.

On lower Elk branch of Knox Creek the following order of beds was developed by the Kentucky Geological Survey. Coal-bed measurements are in inches, and the section reads downward:

1. Coal with 8 inches of cannel at bottom, above the 800-foot level above the river, thus: Coal, 5, slate, coal 10, slate, coal 14, cannel 8. Total, 87 inches.
2. Sandrock interval, 18 feet.
3. Coal thus: Coal 28, parting 19, coal 25. Total of bed, 72 inches.
4. Interval, 120 feet.
5. Coal thus: Coal 6, shale with iron ore 48, coal 18.
6. Interval, 70 feet.
7. Coal thus: Coal 8, in shales.
8. Interval, including 20 feet of sandrock immediately below the 8 inches of coal above, 315 feet.
9. Coal thus: Coal 25 inches, overlaid by 10 feet of sandstone.
10. Interval of shale, 26 feet.
11. Coal thus: Coal 4, shale 2, coal 6, shale 4, coal 8. Total of bed, 19 inches.
12. Interval, 50 feet.
13. Coal thus: Coal 6, shale 11, coal 1, shale 4, coal 7. Shaly sandstone, 5 feet. Coal 11, shale 10 feet. Coal 14. Sandstone below, 40 feet.
14. Interval, 110 feet.
15. Coal stain.
16. Interval, 30 feet.
17. Coal thus: Coal 12, shale 13, coal 2. Total thickness of bed, 27 inches.
18. Sandrock interval, 30 feet.
19. Coal thus: Coal 17, shale 3, coal 4, shale 2, coal 14, shaly sandstone 17, coal 1, shale 1, coal 1, shale 8, coal 10.
20. Interval, about 50 feet.
21. Coal 32 inches, at 30 feet above the creek, one-half mile above the mouth.

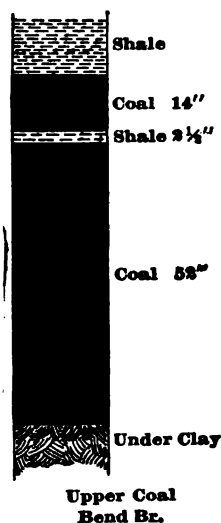
Probably the principal coal would be found in the interval of 315 feet (No. 8 of the foregoing section).



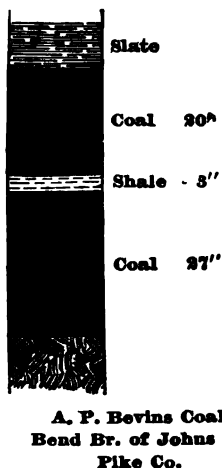


John's Creek and Coon Creek Region.

Returning to the John's Creek region opposite the Pikeville region of the Levisa Fork, the vertical distribution of beds is within the



same limits as in the Little Brushy and John's Creek region previously described. Three beds of the Bend Branch section are workable coals, as will be seen from the measurement given. The upper coal of this section is readily recognized as the Leslie coal of Little Brushy and Caney Creek section. It is a large body of coal with 300 feet of hill rising above it, giving it a large area in the main ridges. The upper part of the lower bench will probably be somewhat slaty when driven to rock roof. The coal at the 375-foot level appears to occupy the place of the Broas coal of Rockcastle and Daniels' creeks, and the lowest bed may be assumed to be the No. 1 of the lower John's Creek region. The identification for the latter bed is favored also by its relation to the cannel coal found at one point on Bend branch, about 70 feet above the lower coal as noted in other localities. The section is drawn from openings made by Mr. Proffitt in the high hill at T. H. Pinson's. The lower coal is also opened on Bend branch at Mr. A. P. Bevins' and driven under roof. The bed-section is as here drawn. Sample for analysis was taken from both benches, in opening driven to firm coal. The analysis follows:



Analysis of Bevins' Coal.

Moisture	1.60
Volatile combustible matter	84.60
Fixed carbon	57.40
Ash	6.40
	100.00
Sulphur	1.708

The bend of the creek in this locality provides the conditions for a good mill site, which has been partly utilized for mill purposes by a canal across in a direct course from which the stream appears to have been deflected to make a long detour around a low hill. The section at the head of Stinking Creek develops no special features. From a rather hasty study of the relation of the rock strata to the drainage level, it appears that the Collins coal at the base of the section is at the horizon of the third coal of the Bend branch section.

The details of the Collins seam are as follows:

Coal	16	inches.
Shale	28	inches.
Coal	9	inches.
Bone coal	2½	inches.
Coal	28	inches.
Total	83½	inches.

A sample was cut from the benches below the 28-inch shale bed, but so near the outcrop as to be somewhat damaged by washings of clay, analysis of which gave the following results:

Moisture	1.46
Volatile combustible matter	81.84
Fixed carbon	56.80
Ash	10.00
	100.00
Sulphur	0.727

The coals in the section above this bed are as reported by Mr. Proffitt, the writer having been prevented from visiting the openings. The location of the openings is omitted from the map.

Across from Bend Branch, on Thompson's branch of Brushy

Creek, 560 feet above the creek, is a cannel bench of 17 inches in a coal-bed opened for local use, as follows:

Sandstone Roof.

Coal	8 inches.
Cannel	17 inches.
Shale	5 inches.
Coal	22 inches.
Total	52 inches.

D'Invilliers gives the order of the coals on Thompson's branch of Brushy Creek as follows:

Beginning 525 feet above the branch and 125 feet below the top of the hill, under sandstone roof. Thickness of beds in inches. Section reads downward:

1. Coal thus: Coal 8, cannel 16, slate 6, coal 19. Total of bed, 49 inches.
2. Interval to next coal below, 61 feet.
3. Coal thus, with sandstone roof: Coal 24, slate 16, coal 21, slate 3, coal 4.
Total of bed, 68 inches.
4. Interval, 161 feet.
5. Coal with slate roof thus: Coal 18, slate 12, coal 9. Total of bed, 89 inches.
6. Interval, 181 feet.
7. Coal in slate, 22 inches.
8. Interval, 100 feet.
9. Coal under slate thus: Coal 18, slate $2\frac{1}{2}$, coal 22. Total of bed, $42\frac{1}{2}$ inches.
10. Interval, 60 feet.
11. Coal 21 inches; falling below the branch at 849 feet above tidewater.

On the left fork of Brushy Creek, beginning with a coal-bed 465 feet above the creek, and reading downward, the section is as follows:

1. Coal thus: Cannel 27, slate 14, coal 20. Total of bed, 61 inches.
2. Interval, 80 feet.
3. Coal, under slate roof, 42 inches.
4. Interval, 107 feet.
5. Coal, under slate, thus: Coal 16, slate 2, coal 9. Total of bed, 27 inches.
6. Interval, 279 feet.
7. Coal, with sandstone roof, thus: Coal 16, bone 3, slate 1, coal 12. Total of bed, 32 inches.
8. Interval to creek below, 21 feet; creek at 941 above tidewater.

These findings confirm the notes of the Survey on the Big Brushy-John's Creek region.

Recently (1905) the principal bed has been opened and driven to solid coal at the mouth of the Burning Fork of Coon Creek, 230 feet above the creek; also at Green Charles' place, at the same height above the main creek, one mile above the mouth of Grassy Creek. The bed-sections at the respective places are as follows:

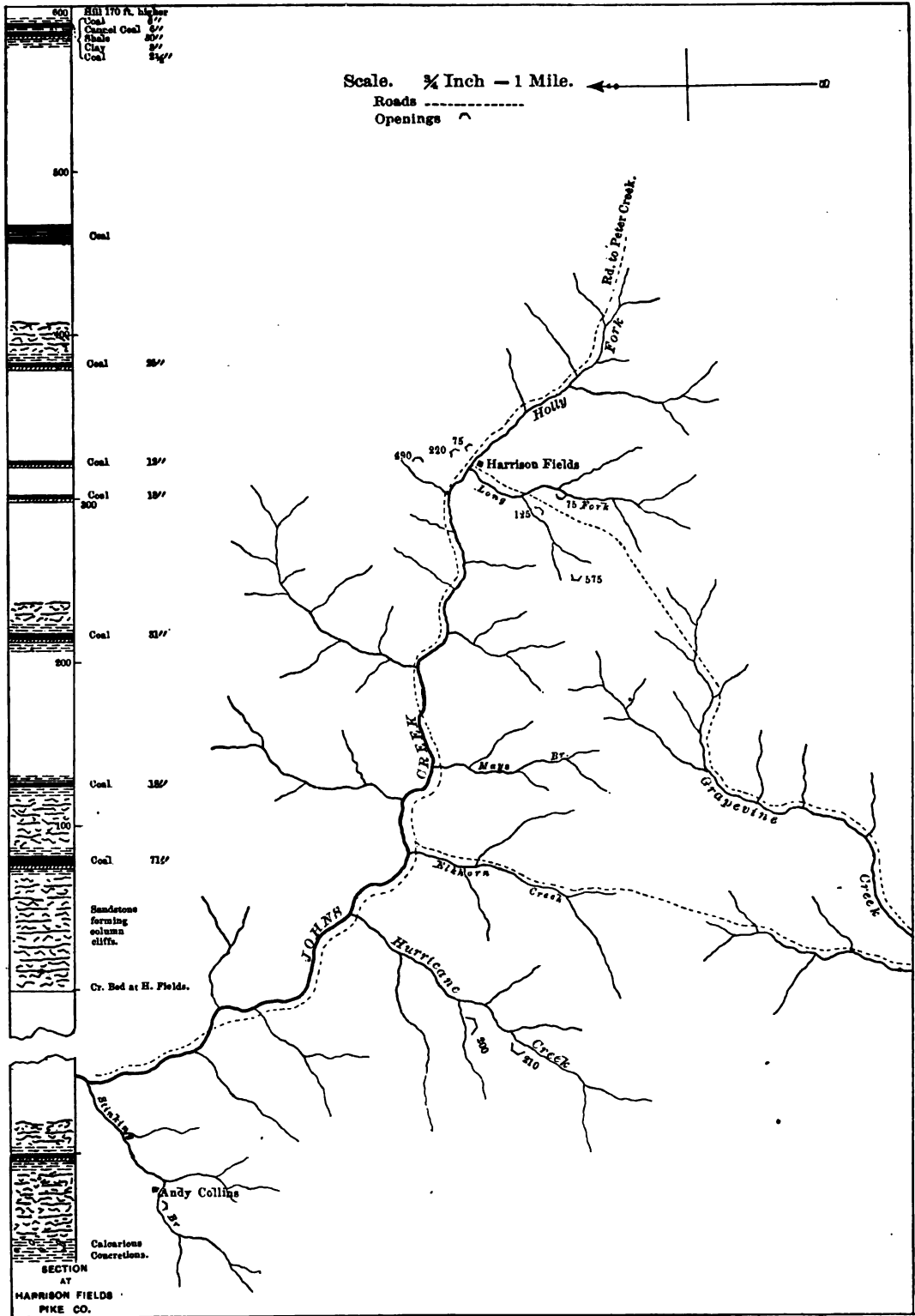
Near Mouth of Burning Fork.		Green Charles's Coal.	
Slate Roof.		Slate Roof.	
Coal	7 inches	Coal	15 inches
Shale	1 inch	Shale	4 inches
Coal	24 inches	Coal	4 inches
Shale	8 inches	Slate	28 inches
Coal	29 inches	Coal	16 inches
		Clay	1 inch
	64 inches	Coal	31 inches
			99 inches

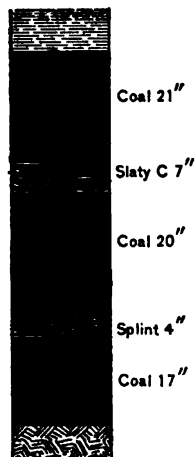
This bed is regarded as the equivalent of the Pikeville coal-bed, opened on the Ferguson Branch, Little Chloe, and Cedar creeks, described in the report on the Pound Gap Region, sections 1, 2, and 3, plate I.* It is now regarded as the equivalent of the lower Elkhorn coal of the regional sections to the southward and southeast.

Region at Head of John's Creek.

There is attached to developments in this region a greatly enhanced interest from the fact that in it, as at the head of Peter Creek, is found the northward extension of the coking coal of the Elkhorn region in specific character, both in bed-section and in quality. As opened 75 feet above the creek at Harrison Fields', and an entry driven to slate roof, this bed shows a thickness of 69 inches, with a slaty band towards the top as noted on Peter Creek. Towards the bottom is a less conspicuous band which may, on driving to solid coal, prove to be either splint or slaty coal. A somewhat weathered sample for analysis was taken from the whole face, excepting the slaty band towards the top. The analysis is as follows:

*Kentucky Geological Survey: Preliminary Reports on the Southeastern Coal Field, 1887. Reprinted in report of the State Inspector of Mines for 1901-1902.



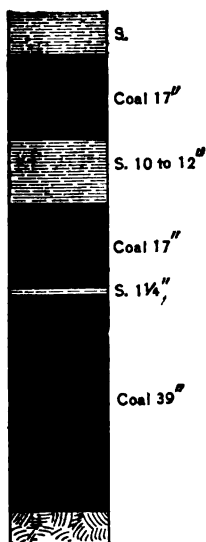


HARRISON FIELD'S COAL
MO. OF LONG FK. OF JOHNS CR.

Analysis of Harrison Field's Coal.

Moisture	1.60
Vol. com. matter	27.94
Fixed carbon	64.26
Ash	6.20
	100.00
Sulphur	0.450

The coals in the hill above are described in the section. The relation of the Collins or the Stinking Branch coal, of the preceding region, to this bed is quite certainly one of equivalency. North of Hurricane Creek, for some distance the dip down the main creek is as great as, or greater than, the fall of the stream. Above this point, up the John's Creek valley, the rock strata also fall below the creek bed; the flow of the creek being nearly westward, and the dip of the rocks locally falling to the north or



C. HURRICANE BR.
OF JOHNS CREEK

to the east of north. An opening made on Hurricane Creek, which empties in John's Creek about 5 miles below the Harrison Fields opening, exposes this bed 230 feet above the main creek. The fall of John's Creek in this distance is about 100 feet, as indicated by the U. S. Geological Survey map. The opening on Hurricane is at Harvey Lane's, a mile or more above the mouth of the creek. The bed-section is as in cut here given. One-half mile further up the creek, at Jeff Lane's, an opening shows nearly the same measurements; the thin slate parting is increased to 5 inches, and the lower bench is correspondingly decreased. At the mouth of Elkhorn

branch, this coal is opened showing the following measurements, as given by D'Invilliers:

Coal	16 inches.
Slate	42 inches.
Coal	4 inches.
Splint	2 inches.
Coal	54 inches.
	118 inches.

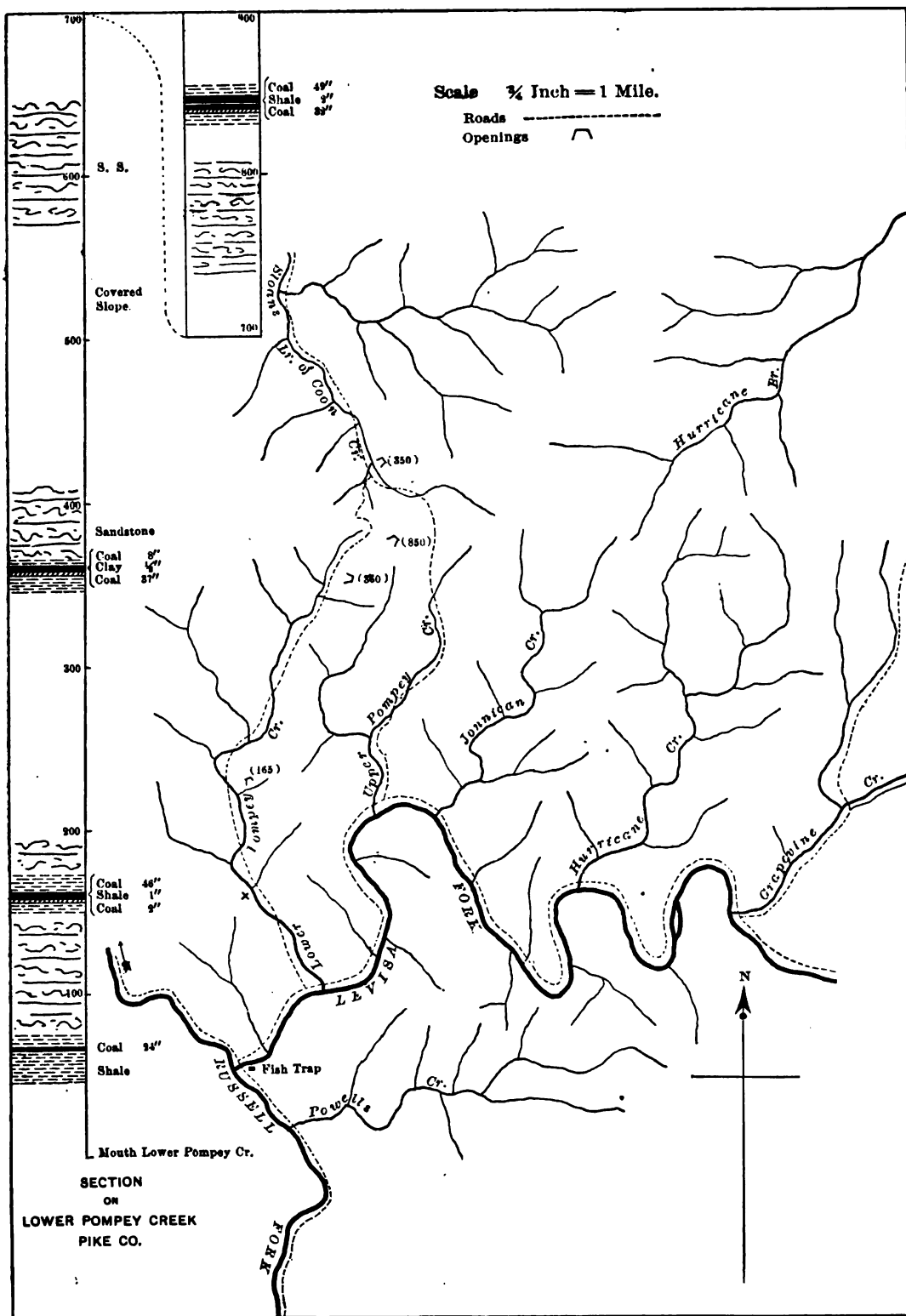
The changes in the character of this coal bed in this region show the approach to the northern boundary of the coking coal field, especially when taken in connection with the regional sections, already described, down the valley of Levisa Fork and of John's Creek. The section of this region may be readily compared with the regional sections on Peter Creek, and on Grapevine over the divide to the Levisa Fork.

Lower Pompey Creek and Levisa Fork Region

The coal-beds of the Lower Pompey section are readily identified as representing beds described in other regions. The coal at the 360-foot level is the coking or Elkhorn seam, reduced in thickness and showing an increase in the percentage of sulphur. The thickness on the head of Lower Pompey, at Joseph Coleman's, is 45 inches, with $\frac{1}{2}$ inch of clay 8 inches from the top of the bed. On the head of Sloan's Fork of Coon Creek, at Jonathan Coleman's, the thickness is 40 inches with $\frac{3}{4}$ inch of clay 1 foot from the top. Sample for the analysis following was taken from the face of the bed, driven under protecting slate roof, at the latter place:

Moisture	1.82
Volatile combustible matter	31.68
Fixed carbon	61.60
Ash	5.40
	100.00
Sulphur	0.949

The lower workable coal-bed, at the 165-foot level, is persistent up the Levisa Fork valley. It is 40 inches thick, with 1 inch of



LOWER POMPEY CREEK AND LEVISA FORK.

Folger Map Co.

clay 2 inches from the bottom. A representative sample was obtained for analysis, giving the following results:

Moisture	1.20
Volatile combustible matter	82.20
Fixed carbon	54.88
Ash	12.22
	100.00
Sulphur	1.511

This bed is here known as the John Robinson coal, being opened on that gentleman's land for local use. It is a good fuel coal, stocking well as lump coal. At the 850-foot level Mr. Proffitt opened a bed of coal nearly 7 feet thick, which, though a good coal, is more important as showing the persistence of the bed than as an economic feature of the region at the present time. Most of the higher hills of the region are capped by the massive sandstone which overlies this bed.

This section may be compared with that on the Little Brushy Creek and with the order of the beds in the section at the head of Pond Creek, where three coal-beds are found under the massive sandstone, which caps most of the high ridges of this part of Pike county.

More recent (1904) openings of the Elkhorn coal on Upper and Lower Pompey show as follows:

Left Fork Lower Pompey.		Upper Pompey.	
Coal	36 inches	Coal	16 inches
Slate	$\frac{1}{2}$ inch	Slate	1 inch
Coal	$6\frac{1}{2}$ inches	Coal	12 inches
Slate	1 inch	Slate	$\frac{1}{2}$ inch
Coal	2 inches	Coal	27 inches
	46 inches		$56\frac{1}{2}$ inches

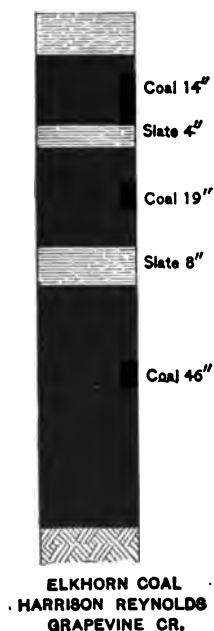
On Jonnican Creek, above Upper Pompey, the order of the beds

is given by D'Inwilliers as follows, the section reading downward, and thicknesses of beds being in inches:

1. Space from hill top, 250 feet.
2. Coal thus: Coal 7, slate 2, coal 8, slate 2, coal 24, slate $\frac{1}{2}$, coal 8. Total of bed $46\frac{1}{2}$ inches.
3. Interval, 110 feet.
4. Coal, 82 inches.
5. Interval, 140 feet.
6. Two thin coals at creek level.

The Levisa Fork and Grapevine Creek Region.

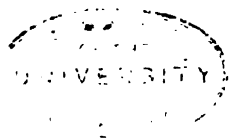
The order of coal mines on Grapevine Creek is like that of the head of John's Creek and of Levisa Fork. Time was not taken to open the Elkhorn coal on the main creek as it was opened on the Left Fork. The coal 200 or more feet higher in the series is apparently the upper Elkhorn bed of the district to the southwest. See also the Big Creek section of Levisa Fork. It is here a thick bed, with partings of clay which detract from its value as indicated by the quality of the coal.



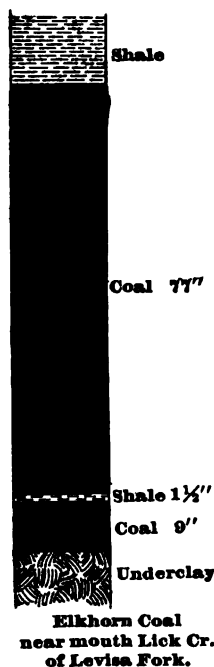
The opening of the Elkhorn seam on the Left Fork of Grapevine shows as in the cut here given. Later developments at the head of the Fork show an increase in the thickness of the middle parting to 18 inches. (The 'Left Fork should have been represented as joining the main creek $\frac{1}{2}$ mile from Levisa Fork). The lower coal, as opened by Harrison Reynolds for a local use, is also a coking coal. Analysis is as follows:

Moisture	1.50 per cent.
Volatile combustible matter . . .	29.66
Fixed carbon	60.34
Ash	8.50
	100.00
Sulphur	0.813

The section of the Levisa Fork below the mouth of Lick Creek is



much more instructive, having been made with the purpose of showing all the beds of the region. The lower bed is increased in thickness as given in the section of the region. The coal is of excellent quality as on Grapevine Creek, resembling the Elkhorn coal in general appearance. An analysis of this coal, as opened on Card Creek, is given in connection with an account of this bed in that region.



The Elkhorn coal, faced up but not driven to roof, shows as in the accompanying drawing of the details of the bed. The sample for analysis necessarily included some clay, increasing the percentage of ash; and the percentage of water is much greater than would be found in the solid coal. The thickness of this bed will be reduced when the opening is driven to solid coal. Analysis of the coal shown in the cut is as follows:

Moisture	5.14 per cent.
Volatile combustible matter	23.96
Fixed carbon	61.90
Ash	9.00

Shale 1½"

Coal 9"

Underclay

	100.00
Sulphur	0.302

Elkhorn Coal
near mouth Lick Cr.
of Levisa Fork.

Making such reductions as should be made from the conditions which obtained, the specific character of the coal is shown by the analysis as well as by the appearance of the coal. The coals above are shown with their surroundings in the section. The bed at the 750-foot level, much split up with slate partings, is of interest as representing the thick coal with parting on Ferrel's Creek of the Russell Fork valley. This is the upper Elkhorn coal of the Russell Fork district.

The Big Creek, Levisa Fork and Card Creek Region.



The same order of the lower beds is found on Big Creek as in the last section. The thin bed at the base of the Lower Pompey section, it will be noticed, increases in thickness up the river. Here it may be regarded as a workable seam, as the coal is of excellent quality. The next bed, which has been called the lower coal, is here like the Elkhorn coal in composition.

A cut showing the bed and its surroundings is here given. Sample for analysis was cut from the bed driven to the solid coal. The upper portion exhibits splint structure.



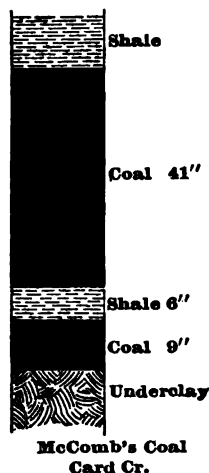
Moisture	1.06 per cent.
Volatile combustible matter . . .	28.78
Fixed carbon	68.96
Ash	6.20
	100.00
Sulphur	0.626

The Elkhorn coal on this creek is as in the detailed drawing. It is to be regretted that, in this region, this coal was not opened by entries to protecting roof, an expense which could not be assumed by the Survey. The sample for analysis (given below) was from near the outcrop of the 74-inch bench; the coal being freer from clay joints than at the place where previously described.

Moisture	2.00
Volatile combustible matter	26.80
Fixed carbon	68.20
Ash	8.00
	100.00
Sulphur	0.481

The opening represented was made on a branch to the right of the creek, going up, at the 600-foot level. The stain of this coal shows in the point above Mr. Phillips' house.

On Fed's Creek, at Alex. Hackney's, 4 miles from Levisa Fork, this seam shows 2 inches of shale 12 inches from the bottom, and a bony layer 2 inches thick 18 inches from the top, in a thickness of 65 inches. Near the head of the creek, the bed is increased to 69 inches of bright coal, without parting, as reported by Sillyman, in an entry driven well under rock roof. Three feet of coal is exposed 165 feet below, in shales.



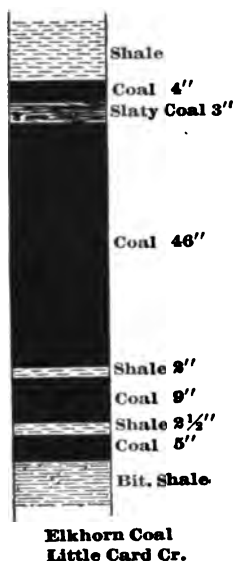
Near the mouth of Card Creek the lower coal shows as in the accompanying cut. The bed here was opened 190 feet above the river by Mr. McCombs. Analysis of it is as follows:

Moisture	4.10 per cent.
Volatile combustible matter	28.90
Fixed carbon	64.58
Ash	7.32
	100.00
Sulphur	1.854

The equivalent in the section is at the 255-foot level probably, and the Elkhorn bed is represented by a 30-inch bed 190 feet higher. The data for a more definite determination of beds was not deemed of sufficient importance for the purpose of this report to warrant a prolonged study of the locality.

The Elkhorn coal was opened on Little Card Creek at the 610-foot level, with the bed-section interrupted by several partings and reduced somewhat in thickness. The details of the bed are shown in the cut herewith. A sample for analysis (given below) was cut from the 46-inch bench,

driven to protecting roof; but the coal was not entirely free from effects of weathering.



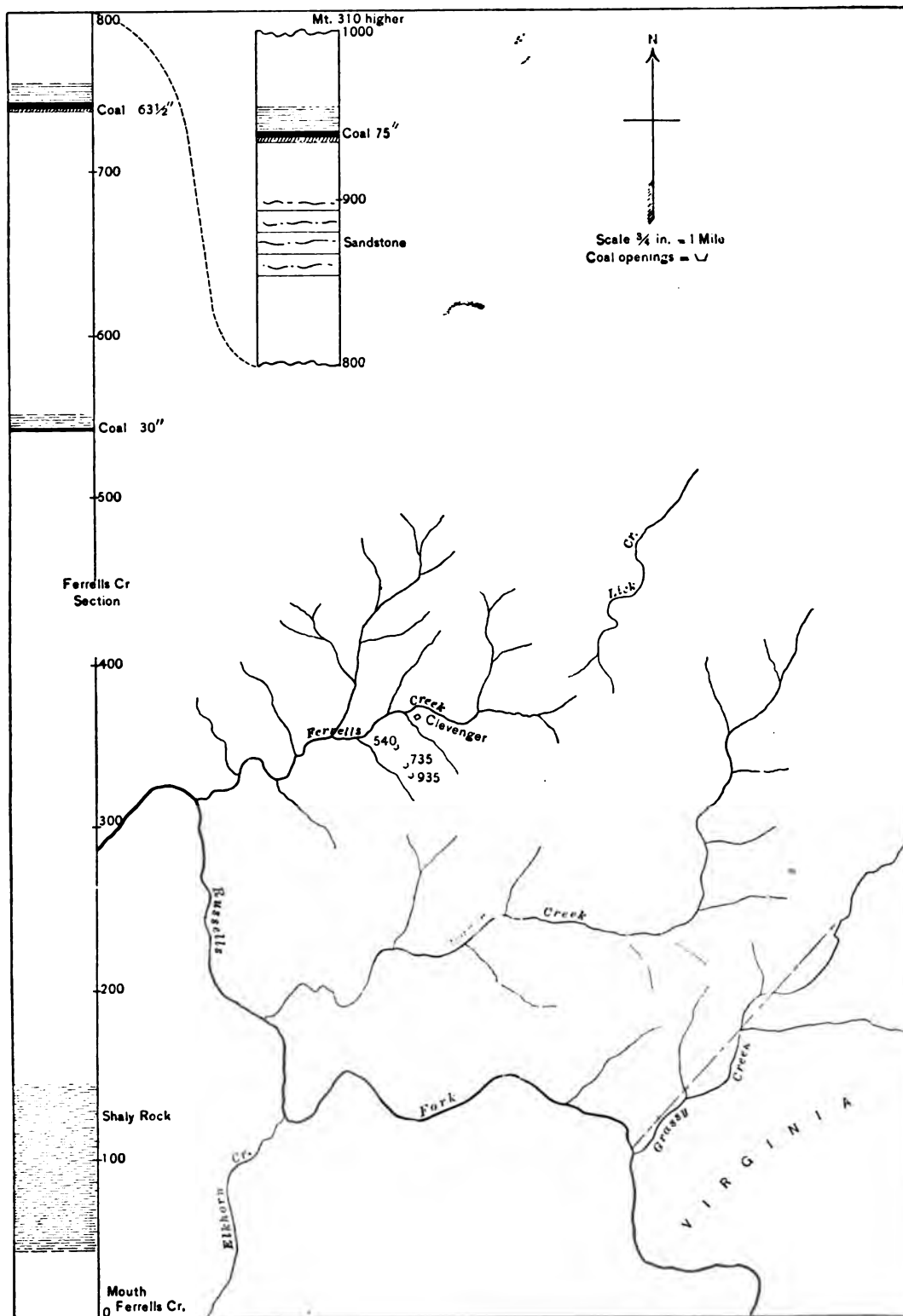
Moisture	5.64
Volatile combustible matter . . .	28.80
Fixed carbon	64.28
Ash	6.80
	100.00
Sulphur	0.549

The equivalent coal beds of Big Creek and on Card Creek are at about the same level, or lower in the latter locality. Across on the Left Fork of Grassy Creek of Russell Fork the lower coals are opened at about the same level as on Card Creek. The northwest dip in the Tug Fork region is changed to a nearly horizontal stratification in this direction by the Grassy Creek fault, by which the equivalent beds on the Kentucky side of the Left Fork of

Grassy Creek are more than 400 feet lower than on the Right Fork in Virginia. This difference rapidly disappears, apparently, northeastward along the State line. The lower coals on the Left Fork of Grassy Creek are separated by 100 to 130 feet of mostly shaly rock, the lower bed varying very little from 30 inches of coal in one bench; the other varies greatly in the same localities. Opened on Old House Fork and on Trace Fork, on both left and right sides going up, it shows as follows:

On Old House Fork.

LEFT SIDE.	RIGHT SIDE.
Slate roof.	Slate roof.
Coal 40 inches	Coal 49 inches
Slate 3	Slate 9
Coal 6	Coal 9
Total, 49 inches	Total, 67 inches



RUSSELL'S FORK AND FERRELL'S CREEK.

On Trace Fork.

LEFT SIDE.	RIGHT SIDE.
Coal 4 inches	Coal 4 inches
Slate 1	Slate 8
Coal 5	Coal 8
Slate 4	Slate 8
Coal 17	Coal 17
Slate 5	Slate 10½
Coal 29	Coal 8
—	Slate ½
Total, 65 inches	Coal 15
	—
	Total, 64 inches

The upper coal-beds have not been opened on the Left Fork of Grassy. At the head of the Right Fork in Virginia one of the higher coals, probably the Elkhorn bed, shows a thickness of 50 inches, including 1 inch of clay 3 inches from the top. The intervening fault and the southwest dip in Virginia along the extension of the Pine Mountain axis give to this suggestion of equivalency a limited value. The succession of beds on the heads of Russell and Levisa Fork in Virginia is not readily comparable with the vertical distribution in Kentucky, without a more detailed development of the Virginia section.

The Russell's Fork and Ferrell's Creek Region.

The lower beds of the preceding section were traced and opened on Ferrell's Creek high above the river. The Elkhorn coal is a little more than half-way up the slope of the hills of the locality. Westward and southwestward, the beds fall to near the base of the hills within the area which may properly be called the Elkhorn Coking Coal Field. As found here it is as in the accompanying cut. It was not driven to roof; thin clay partings may be found when driven to solid coal.

The sample for the analysis, given below, was from a badly weathered face, which accounts for the excessive percentage of water, while the infiltrated earth increased the percentage of ash; a de-

crease in sulphur is probable. With this explanation, the result is in keeping with the high estimate entertained of the value of this bed.



Moisture	7.70 per cent
Volatile combustible matter	23.30
Fixed carbon	61.46
Ash	7.48
	100.00
Sulphur	0.567

This bed is now known as the Lower Elkhorn coal. Other openings on Ferrell's Creek have been made near the head of Left Fork 1,463 feet above tidewater. The bed as noted on a recent visit to the Elkhorn region is as here represented. Fol-

lowing is an analysis of the coal made for the Big Sandy Company; R. A. Hellier, General Manager:

Moisture	2.89
Volatile combustible matter	82.21
Fixed carbon	59.90
Ash	4.88
	99.88
Sulphur	0.67
	100.00
Phosphorus	0.008



FERRELLS CR. COAL.
LEFT FORK AT HD.

D'Invilliers is authority for the following data of thicknesses, etc., of the Elkhorn coal:

Middle Fork of Ferrell's Creek, 64 inches, 1475 feet above tide.

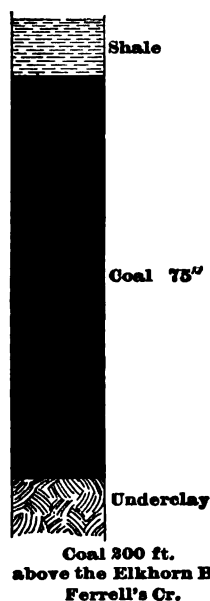
Near head of main creek, 69 inches, 1450 feet above tide.

On Ellswick Fork of Lick Creek, across on Levisa Fork waters, 72 inches, 1527 feet above tide.

On the head of Road Creek, of Russell's Fork, 47 inches.

Two hundred feet higher in the hill an unusual development of

the next regular bed was found by the Survey. The thickness, driven to roof, is 75 inches without slate-rock partings. The sample collected for analysis, as in the preceding instance, was weathered (but from whole face of bed) and is subject to same objections. Following is the analysis:



Moisture	7.54 per cent.
Volatile combustible matter	25.14
Fixed carbon	60.60
Ash	6.72

100.00

Sulphur	0.428
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This bed is variable in thickness and in the matter of partings. Two openings recently made (1905) on Ferrell's Creek show as follows, reading down:

Coal	8½ inches	Coal	23 inches
Slate	1	Slate	2
Coal	4	Coal	21½
Slate	2		
Coal	.55	Total	46½ inches
Total	70½ inches		

The character and thickness of the Elkhorn seam, as well as its place in the series are well established in this region and in the regions across the Russell Fork. The coal-bed, about 190 feet below, in the Big Creek, Grapevine and other sections, is here 30 inches thick and 540 feet above the Russell Fork.

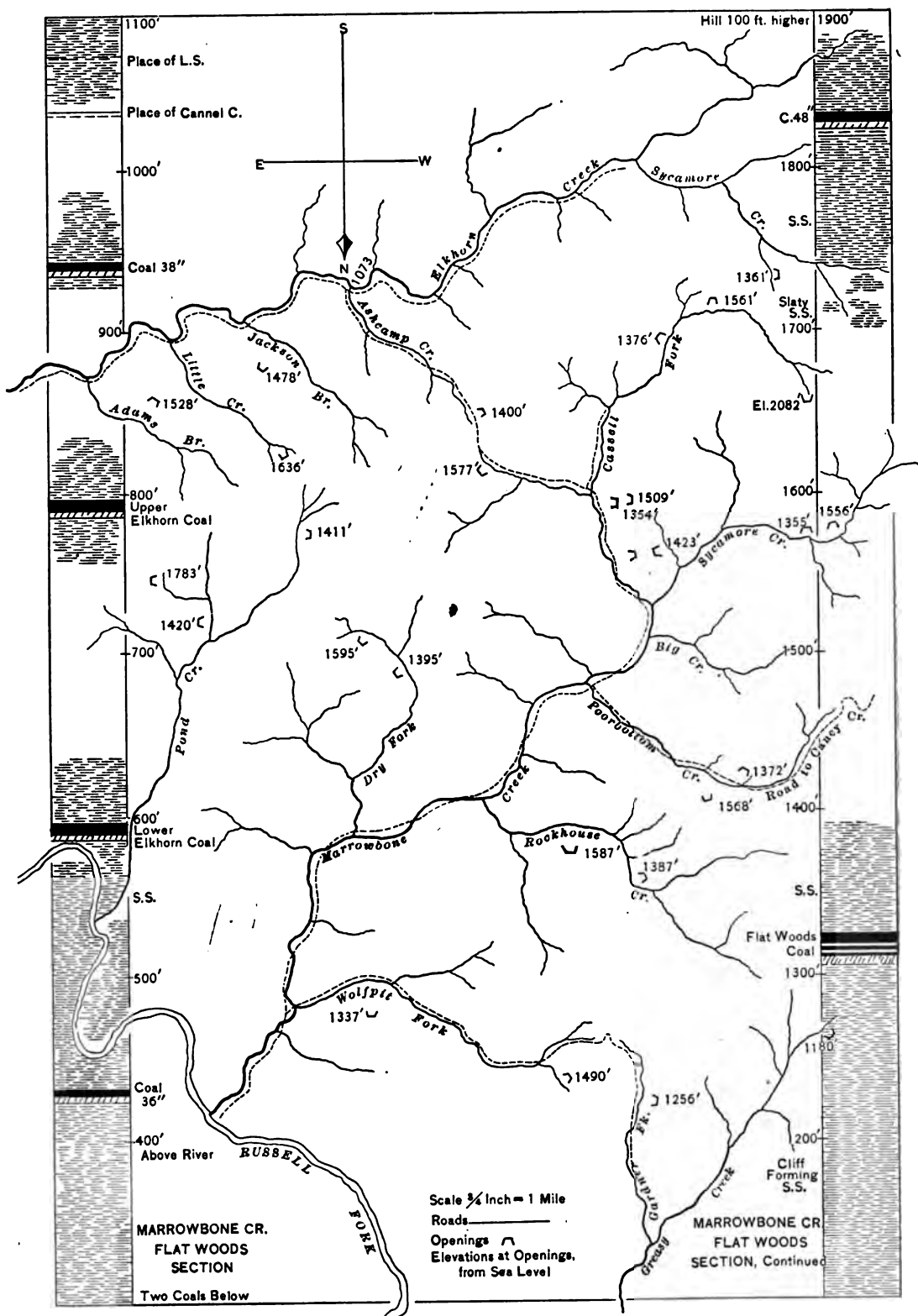
The steep slopes of the hills rising from the river bottom are composed mostly of shales and slaty rocks, indicating for the shale series above the Conglomerate a thickness of 500 feet or more, instead of 200 feet or less, as at Paintsville in Johnson county.

The Marrowbone Creek, Flat Woods Region.

The coal-beds of this district have been prospected in so systematic a manner that for the more prominent beds the vertical distribution and local dip can be seen from the map prepared under the direction of D'Inwilliers for the Big Sandy Company. The page map, which will be made the basis of a description of this district, is prepared from the above mentioned map, giving such openings of the many that have been made as are necessary for the purpose of this report. The section at the margin represents 1,600 feet of vertical height beginning 300 feet or a little more above the Russell Fork, and including Carboniferous rocks, to the Flat Woods tableland, above which hill-tops rise 150 feet or more. The Conglomerate formation would be reached by the drill at probably less than 100 feet below the mouth of Elkhorn Creek. The whole thickness of the Coal Measures above the Conglomerate series is, therefore, from 2,000 to 2,100 feet. Two local beds of value are found in the 300 feet below the section here given, the so-called Ellswick and Auxier seams. The former shows above the drainage near the mouth of the Elkhorn Creek; the latter at 150 feet or more higher, and above the Russell Fork with the dip down to the river, and above Elkhorn Creek for about two miles up the creek. These beds range in thickness from 3 to 4 feet of coal, excluding partings of slate or slaty coal which vary from 3 to 14 inches. Near the mouth of Moore Creek the Auxier seam is locally thickened to 64 inches, excluding 7 inches of rock.

Analysis made for the Big Sandy Company give the following results for these beds:

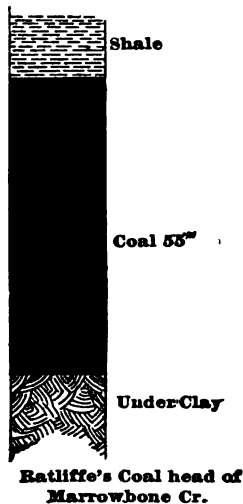
	Auxier	Ellswick
Moisture	0.650	0.650
Volatile combustible matter	29.960	30.550
Fixed carbon	58.980	59.239
Ash	9.720	8.180
Sulphur	0.690	1.381
	100.000	100.000



MARROWBONE AND FLATWOOD'S REGION.

The third bed has an average of about 3 feet, so far as known; but few openings have been made in it.

The Elkhorn seam proper, the Lower Elkhorn of this district, is opened at many points and is so uniformly of a workable thickness as to give promise of an uninterrupted extension over the district in the hills which rise above the 1,400-foot level above the sea, or the 600-foot level above Russell Fork. Openings representing a large area are located on the page map. A typical bed-section with analysis is here given:



Moisture	.92 per cent.
Volatile combustible matter . . .	36.78
Fixed carbon	58.08
Ash	4.22
	100.00
Sulphur	0.470
Phosphorus	0.006

The thickness of the bed in the several localities indicated on the map is as follows, the thicknesses being in inches:

Sycamore Creek of Elkhorn Creek	Coal 56,
Ash Camp of Elkhorn Creek	Coal 54,
Pond Creek	Coal 53,
Wolfpit Fork of Marrowbone	Coal 40, S. 7- $\frac{1}{2}$, C. 19.
Dry Fork of Marrowbone	Coal 51,
Rock Fork of Marrowbone	Coal 51,
Poor Bottom Fork of Marrowbone	Coal 53,
Sycamore Fork of Marrowbone	Coal 53,
Marrowbone Creek near mouth of Cassell Fork . . .	Coal 56,
Cassell Fork	Coal 54,
Grassy Creek	Coal 82, S. 5, C. 24.
Caney Creek of Shelby Creek	Coal 51,

This bed falls below the drainage towards the heads of the creeks and is covered in this field by from 100 to 1,400 feet of coal measure rocks.

The upper Elkhorn seam is from 175 to 200 feet higher in the series, as will be noticed in general by the elevations given. This

bed is more variable in bed-sections but is a coking coal and in character may very readily be mistaken for the Lower Elkhorn.

The bed-section here represented is of the Upper Elkhorn bed near the mouth of Sycamore Fork of Marrowbone Creek. Sample for analysis was taken from both benches. The upper bench was not driven to solid coal and shows more ash, more moisture and less sulphur than will be found in the unweathered coal:



	Upper Bench.	Lower Bench.
Moisture	9.10 per cent.	1.40 per cent.
Volatile comb. matter	25.58	34.06
Fixed carbon	58.62	61.70
Ash	6.70	2.84
	100.00	100.00
Sulphur	0.829	0.738

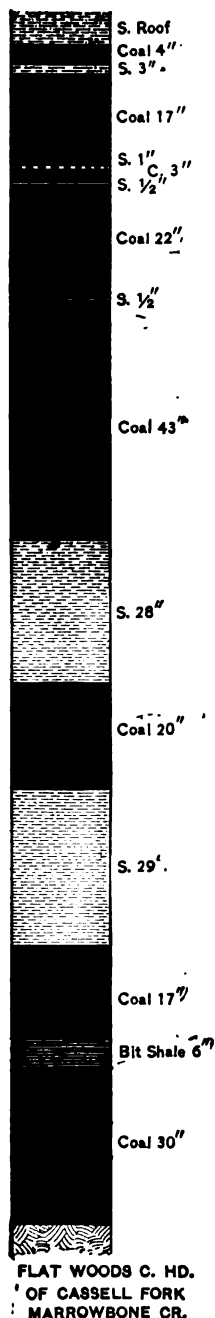
The upper bench represents this bed as developed in most of the district. The average thickness will be seen from the following measurements, which are given in inches. Additional benches read downward:

Barley's Coal
Marrowbone Cr.

Old House Branch of Marrowbone Creek . . .	Coal 53
Near Head of Wolfpit Fork	Coal 51
Dry Fork of Marrowbone	Coal 52
Rockhouse Fork of Marrowbone	Coal 54
Sycamore Fork of Marrowbone	Coal 49, S. 1, C. 6, S. 10, C. 30
Gap Head of Ash Camp Creek	Coal 48
Near Mouth of Cassell's Fork of Marrowbone	Coal 45, S. 12, C. 37
Cassell Fork of Marrowbone	Coal 52
Daniel's Branch of Caney Cr. of Shelby Cr.	Coal 55, S. 2, C. 37.

The lower bench of the Daniel's Branch coal shows slaty and bone coal layers in the lower 9 inches. As compared with the Lower Elkhorn seam the area of this bed is reduced by the slope of the hills and possibly by the local thinning out of principal bench. The outcrop has been traced over the greater part of the region.

Higher in the vertical section at 150 feet, a coal is reported at a



few points, varying in thickness from 25 inches to more than 48 inches. As opened by the Survey near the mount of Sycamore Fork of Marrowbone Creek, it showed 38 inches, including two thin seams of clay. This is also probably the same as the 34-inch coal noted on Sycamore Fork of Elkhorn Creek, and 360 feet above the Lower Elkhorn coal. This bed is of little importance in this district.

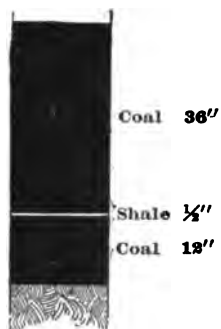
The Flat Woods coal, nearly 550 above the upper Elkhorn, is notable for its thickness of bed-section, which is represented in detail in the cut here given.

The upper part of this seam was opened by R. C. B. Thruston for the Survey, on Sycamore Fork of Elkhorn Creek, showing 92 inches of coal as given in a previous report. The opening here given was made under the direction of R. A. Hellier, General Manager of the Big Sandy Company, who also gives the following analysis as indicating the character of the coal:

Moisture	8.594 per cent.
Volatile combustible matter . . .	85.156
Fixed carbon	57.796
Ash	7.750
Sulphur	0.708

The bed is opened by benching and no part is driven to solid coal.

The Flat Woods, as a table land, rises more than 500 feet above this coal, and hill tops are 150 feet higher, as indicated by barometer. At the head of the Right Fork of Sycamore of Elkhorn Creek the upper coal of this series

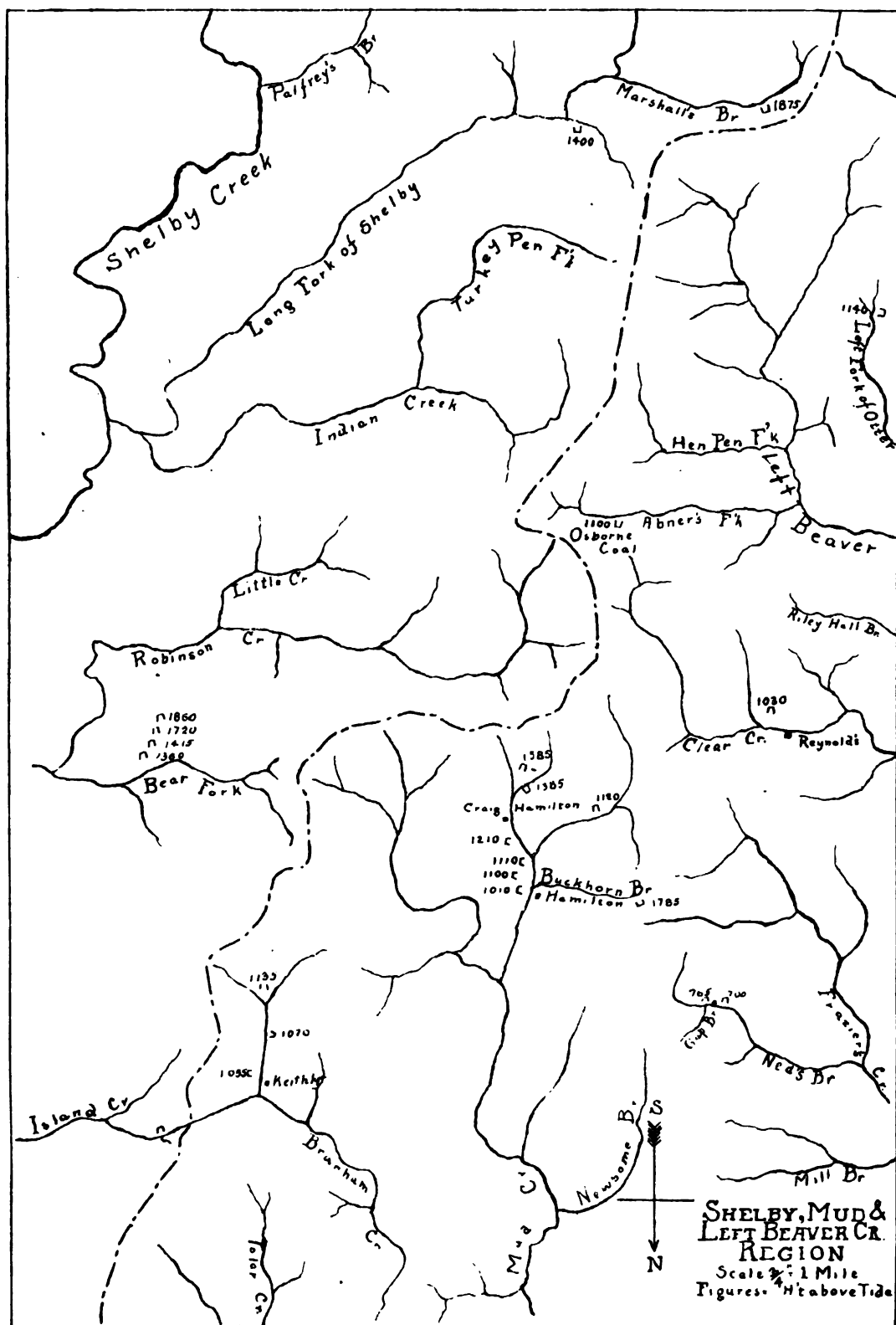


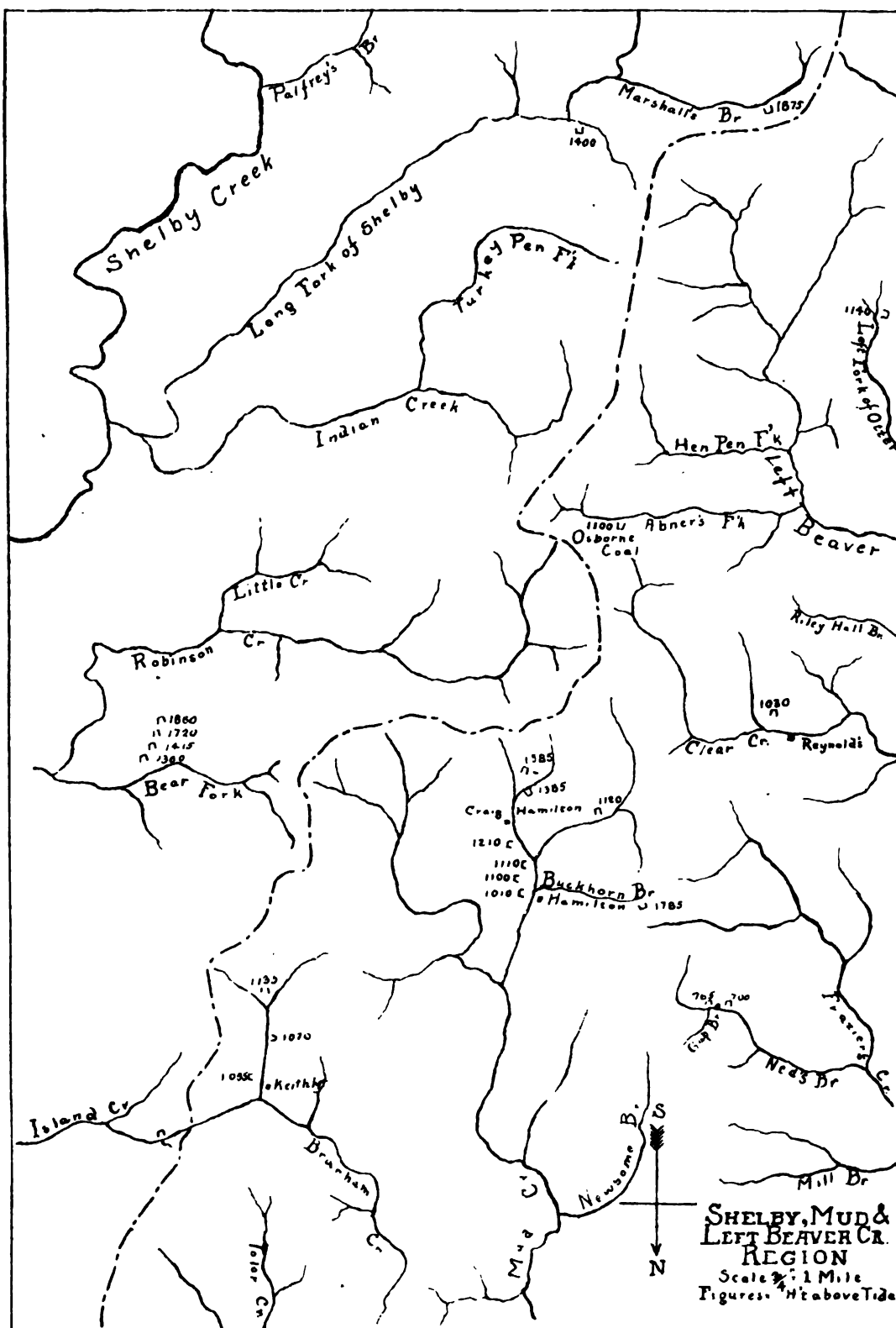
"Flat Woods" Coal
Hd. of Sycamore Cr.
Pike Co.

was opened by Mr. Proffitt for the Survey, showing 48 inches bed-section as in the cut.

Sample from near the outcrop gives the following results by analysis.

Moisture	2.00 per cent.
Volatile combustible matter . . .	88.70
Fixed carbon	58.70
Ash	5.60
Sulphur	<u>0.560</u>





value by shale partings; at one point showing four feet of shale above a 40-inch bench of coal and an upper bench of 18 inches. The lower coal in this section is locally a workable seam.

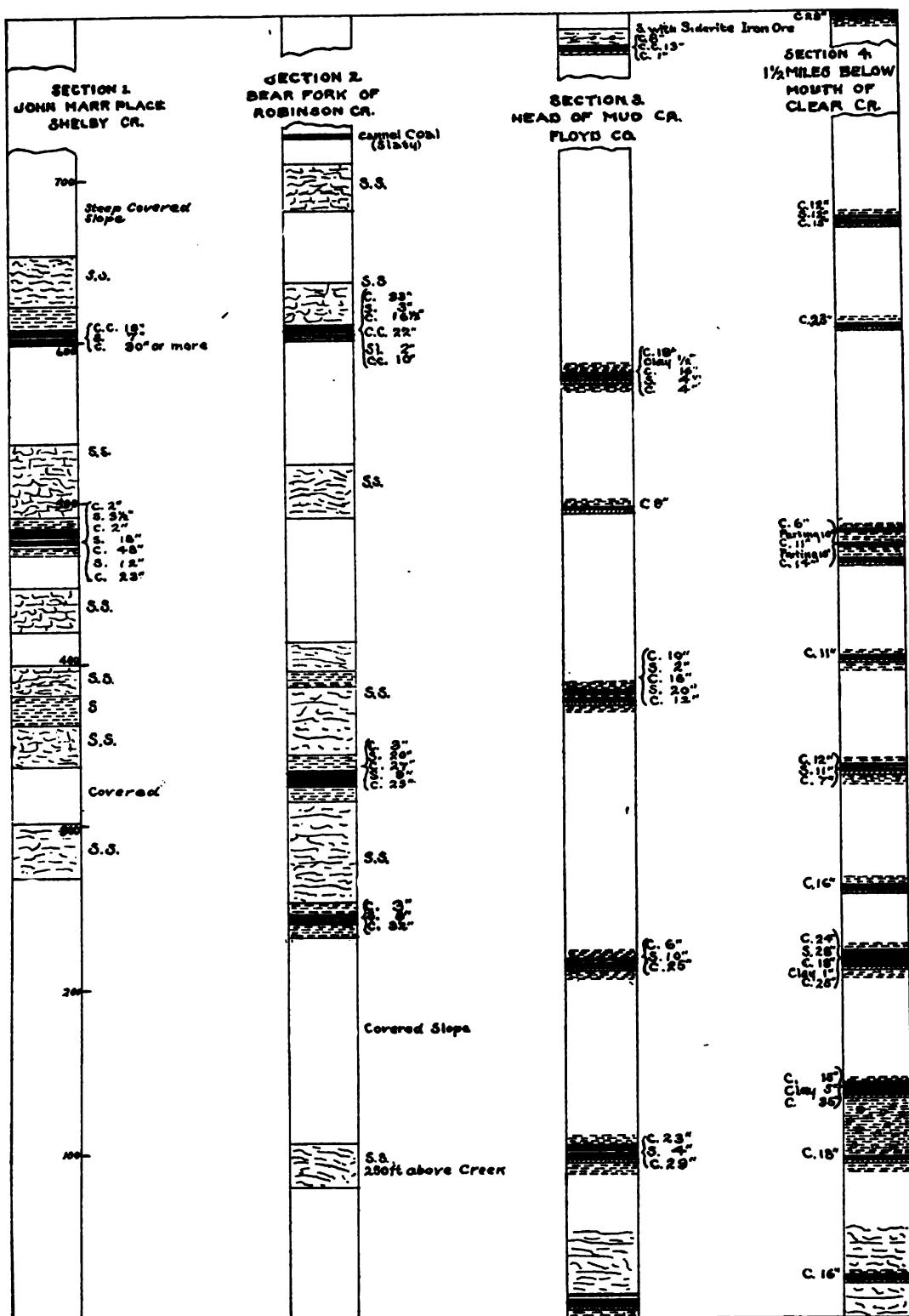
On Branham's Creek, at 1055, this bed is 36 inches in one bench. On Ned's Branch of Frozen Creek, at Wilson Hall's, it is 48 inches of good coal.

In section 1, copied from a previous report, a cannel seam is shown 700 feet above the Main Shelby Creek.

The irregular order of beds above the Elkhorn seam is shown in section 3 and 4 of the accompanying plate. The Upper Elkhorn coal is not continued in place and character westward from the Marrowbone region across this region, though the prominent coal near the 450-foot level in the Bear Fork section probably represents this bed, and the Lower Elkhorn should be found 150 or more below. The correlation of beds in this region is not clearly indicated by the developments shown by the sections of this and the following region. It appears that there are three cannel coal horizons, of which the Bear Fork cannel is the most promising; and omitting the thin coals which do not, so far as known, represent workable beds, there are in this region five or six coal horizons which will sooner or later be found to contribute to the coal resources of the region. Of these, the Lower Elkhorn seam is the most important, as regards both area and workable bed-section. This bed and the workable bed below are coking coals, but appear to be less distinctly so northward and westward, in which directions they become block-like and more suited to marketing as coal.

Analyses of average samples of the Elkhorn coal, by Prof. A. S. McCreath, are added as representative results:

Locality.	Eleva- tion.	Thickness in inches.	Moisture.	Vol. Com. matter.	Fixed Carbon.	Ash	Sul.
Head of Frazer Cr. .	965	69	2.60	87.51	54.98	4.10	0.809
Head of Mud Cr. . .	1120	58	1.96	88.67	55.68	2.92	0.812
Clear Creek	1080	62	2.00	87.77	56.12	3.46	0.645
Lower Coal Head of Big Mud Creek . .	1010	42-47	1.06	88.40	56.54	9.00	0.701



SECTIONS IN PIKE AND FLOYD COUNTIES.

Upper Beaver Creek Region.

The drainage map of this region and of the preceding one is reduced from the map which is the result of surveys and compilations by the Northern Coal and Coke Company, which has also carried the work of developing the Elkhorn coal across this region, much more definitely than the Survey was able to do.

The vertical section at the right of the regional map shows most of the coal horizons at the head of the Right Fork of Beaver Creek. A section made at the mouth of Joneses Fork of Right Beaver is added by way of supplement and comparison. Although the upper beds were not all driven to rock roof, it is certain that as a whole they are reduced in importance on Right Beaver as compared with the preceding region. The coal below the Elkhorn seam is opened on Frazer Creek at 785 and 800 feet, 135 feet above the creek, and on Doty Branch at 775 feet, showing 44 to 46 inches of coal on the former and 50 inches at Eli Stumba's on the latter stream, about 100 feet above left Left Beaver Creek. It is also opened 2 miles below the mouth of Clear Creek, as a workable bed. See cut* with analysis.

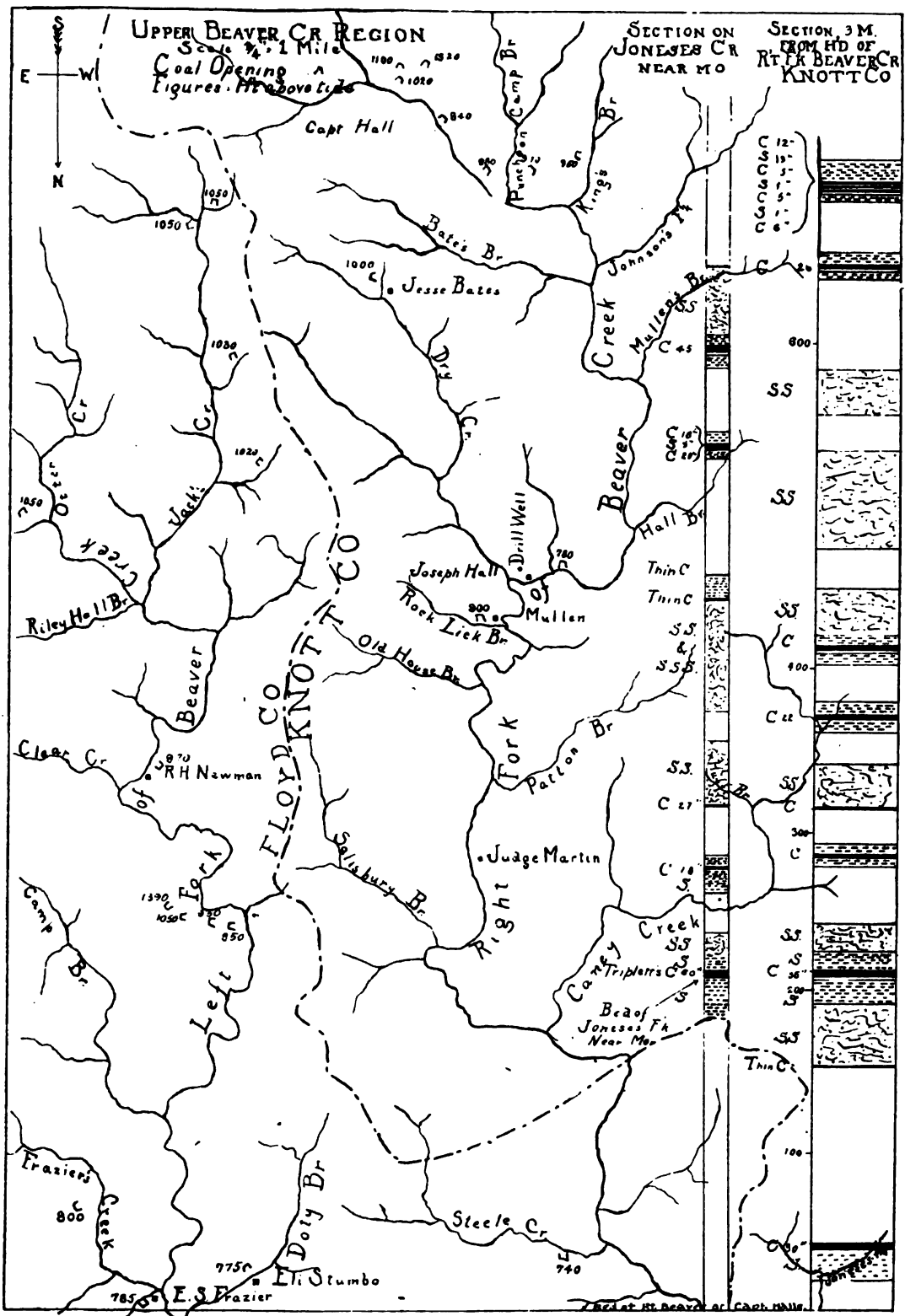
On the Right Fork of Beaver 30 to 36 inches of coal has been found at this level; $\frac{1}{2}$ mile or more above the mouth of Dry Fork of Right Beaver 48 inches of good coal is found about 75 feet lower in the series. This coal was also formerly exposed in a landslide $\frac{1}{2}$ mile further up the creek, showing two 24-inch benches, separated by 3 inches of shale. The quality of these beds is like that of the Elkhorn seam, but little has been done to trace them across the region as a whole, since they are less prominent, at best, than

*The cut is labeled as "Lower Coal two miles above mouth of Frazer Creek;" but as is shown by the map, the distance is greater.

the Elkhorn seam, and more difficult to trace by stratigraphic relations. The exposures of the Elkhorn coal are as follows:

Locality	Elevation Abv. Tide.	Above Drainage.	Bed Section. In Inches.
Near mouth of Otter Creek	1050	240	Roof S. Coal 58.
Hd. of Jacks Creek	1050	10	Roof S. S. Coal 58.
Jacks Creek Honey Camp Br., . . .	1020	120 above J. Cr.	Roof S. C 42, S 4, C 9. Total of bed, 55 inches.
Jacks Creek, Halls Branch . . .	1020	220 above J. Cr.	Roof S. Coal 48,
One-half mile above mouth Clear Creek	970	275	Roof S. S., C 17, S 7- $\frac{1}{2}$, C 41 Total of bed, 65 $\frac{1}{2}$ inches.
Two miles below mouth Clear Creek	980	210	Roof S. C 24, S 28, C 18, C 11, C 25. Total of bed, 96 inches.
Steele Creek	740	50	Roof S. C 25, S $\frac{1}{2}$, C 26, S 1 $\frac{1}{2}$, C 7, S 6, C 11. Total of bed, 77 inches.
Mouth of Joneses Fork, Right Beaver	700	80	Roof S. 18 to S 8, C 54, Slaty C 6. Total of bed, 60 inches.
Huff's Branch of Caney Creek . . .			Roof S. C 40, S 1, C 18. Total of bed, 59 inches.
Rock Lick Branch, Right Beaver . . .	900	225	Roof S. C 4, S 12, C 54, S 2 $\frac{1}{2}$, C 2, S 5, C 8. Total of bed, 87 $\frac{1}{2}$ inches.
Dry Fork, Jesse Bates	1000	95	Roof S. C 70, S 8, C 14. Total of bed, 87 inches.
Same	1005	100	Roof S. C 40, C 11 $\frac{1}{2}$, C 11. Total of bed, 52 $\frac{1}{2}$ inches.
King's Branch, Right Beaver	960	170	Roof S. C 4, S 6, C 28, Shaly C 1, C 88, S 11, C 4. Total of bed, 82 inches.
Adam's Puncheon Camp Branch . .	970	180	Roof S. C 4, S 12, C 68, S and bone $\frac{1}{2}$, C 8, S 2, C 12. Total of bed, 110 $\frac{1}{2}$ inches.
Lindsay King's Coal	980	205	Roof S. with two thin coals: C 68, S 8, C 22. Total of bed, 98 inches.
Near Head of Right Beaver	1020	210	Coal 86.

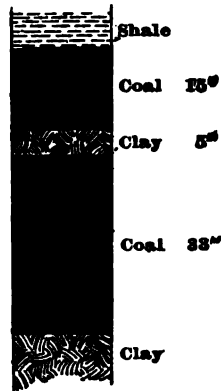
Probably the last one does not show the whole bed. Most of the openings are driven to solid roof rock. The 68-inch bench at



970 and 980, near head of the Right Fork of Beaver Creek, show traces of shaly coal an inch or more in thickness at 30 inches from the bottom.

Analyses from average samples from some of these openings, made by McCreath for the Northern Coal & Coke Company, and by Dr. Peter for the Survey, serve as an indication of the value of the coal for various purposes to which it is suited.

Location.	Ele.	Water.	Vol. Com. Mat.	Fix. Car.	Ash.	Sul.
Jos. King's Br. . .	970	1.900	87.480	55.701	3.87	1.099
Same, Coke . . .		0.182	1.398	91.757	5.905	0.768
Hd. Jacks Cr. . .	1050	3.80	33.80	58.60	3.80	0.788
Steele Cr.	740	2.50	32.50	56.54	3.00	0.650



Lower Coal
two miles above Mo. of
Fraser's Cr.
Left Fk. of Beaver Cr.

The lower coal at 850 feet above tide, two miles below the mouth of Clear Creek on Left Fork, shows 48 inches of coal as in the cut of bed-section here given:*

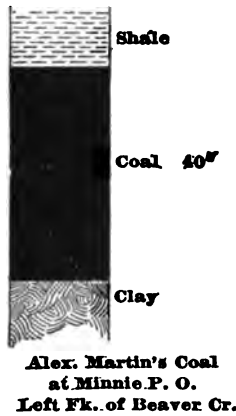
An analyses by Dr. Peter of average sample shows as follows:

Moisture	4.68
Volatile combustible matter	30.06
Fixed carbon	62.14
Ash	3.12
	100.00
Sulphur	.487

* As shown by the map, the distance above the mouth of Fraser Creek indicated in the title of the cut, is too little.

The Lower Left Beaver Region.

The coals developed along the valley of the Left Fork of Beaver Creek are mostly the lower beds. In the hills at Salisbury's, the beds represented in the section at the right margin of the accompanying page map, were found and opened to roof rock but not to unbroken coal. The hills of the region are 700 to 800 feet high. Whether the lower bed is the No. 1 coal so frequently beginning the series in the Big Sandy valley below is undetermined. The Elkhorn seam is not recognized by any features characteristic of that coal. At Alex. Martin's, a mile and a quarter up the creek,



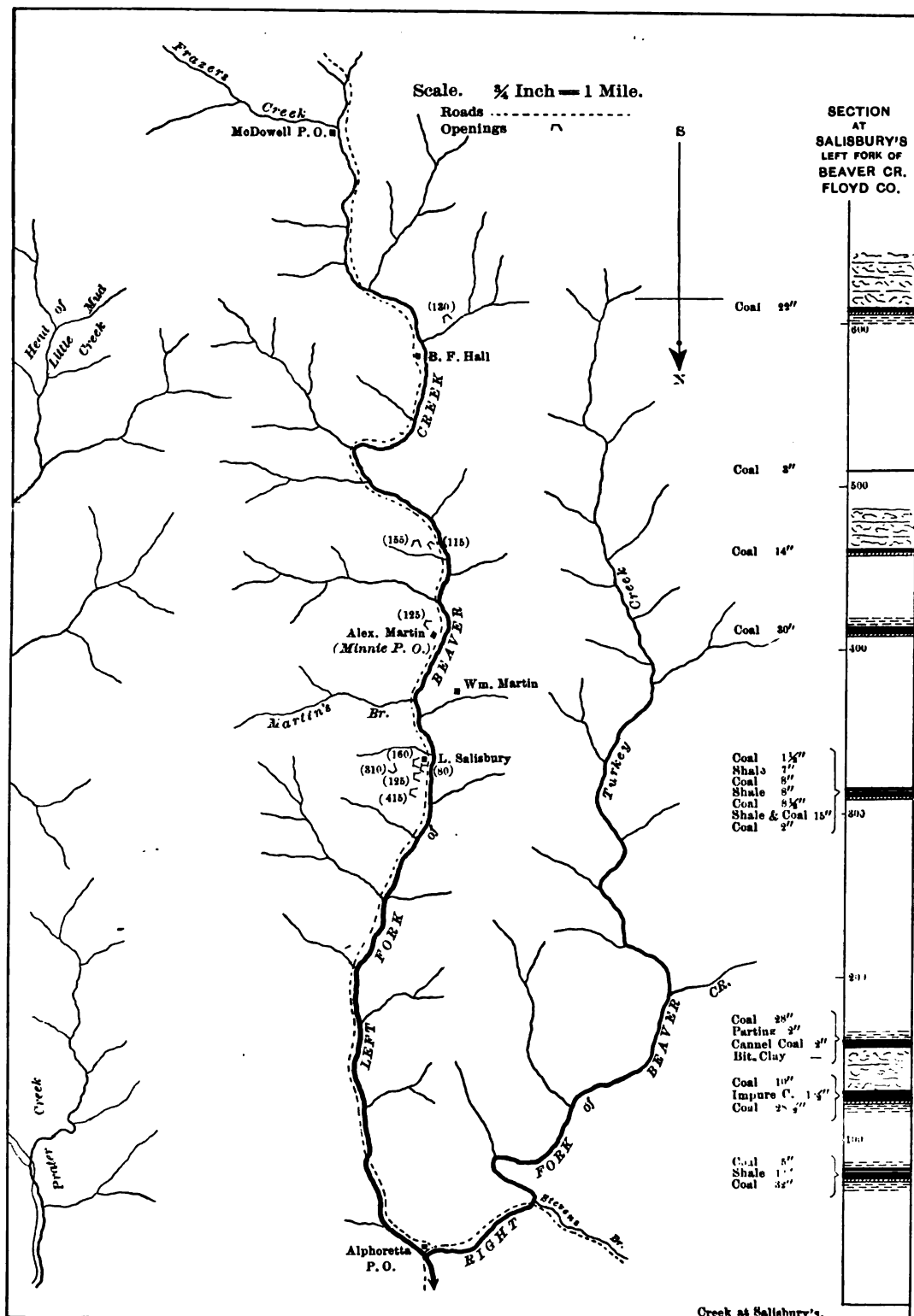
a bed is opened which is doubtless the second of the series represented by the section, since it is under a ledge of sandstone traceable the greater part of the way between the two points. It exhibits an unbroken bed-section as in the accompanying cut. The bed is driven to solid coal for local use. Following is an analysis of the bed:

Moisture	1.80
Volatile combustible matter	82.76
Fixed carbon	58.44
Ash	7.00
	100.00
Sulphur	0.467



B. F. Hall's Coal
Left Fk. of Beaver Cr.
two m's. below Frazer's Cr.

Three-fourths of a mile further up the creek, this bed shows the same thickness and character at the 115-foot level, with a cannel coal 18 inches thick, 40 feet higher in the series. If this cannel is at the horizon of No. 2A of the General Section, this part of the section here is greatly shortened. Near B. F. Hall's the "40-inch bed" is again opened, 130 feet above the creek, with slightly increased thickness but essentially the same in character and surroundings.



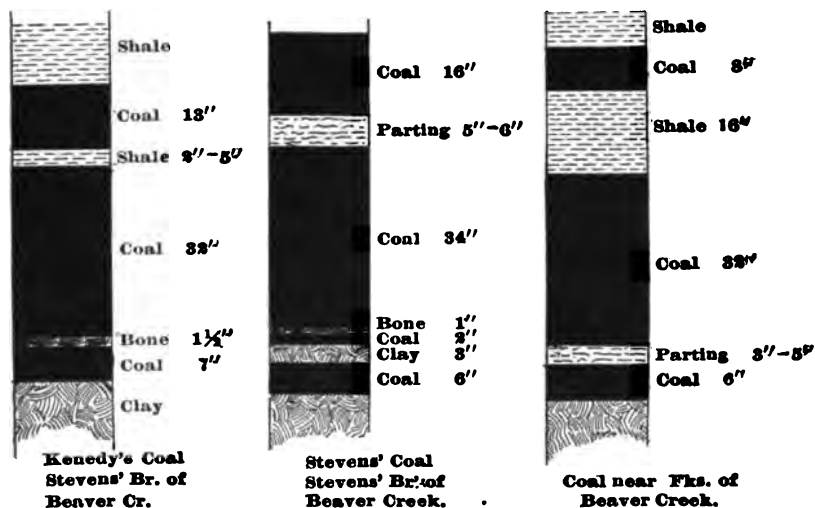
LOWER LEFT BEAVER REGION.

The appearance and surroundings of this bed are like that already described at the Mouth of Frozen Creek, and on Doty Branch at about the same elevation above Left Beaver, under a sandrock ledge which forms the roof of that coal and is below the Elkhorn seam further up Beaver Creek and Frozen Creek. It is probable, therefore, that the Elkhorn bed is limited in this direction to the preceding region; or, while results are not at hand to determine definitely the extension of the Elkhorn bed down the Levisa Fork, it is probable that its place in the series in the Lower Beaver region will not be determined by its importance as a workable coal seam. As such it disappears from the greatly shortened section northward from the Elkhorn field.

Middle and Beaver Creek Region.

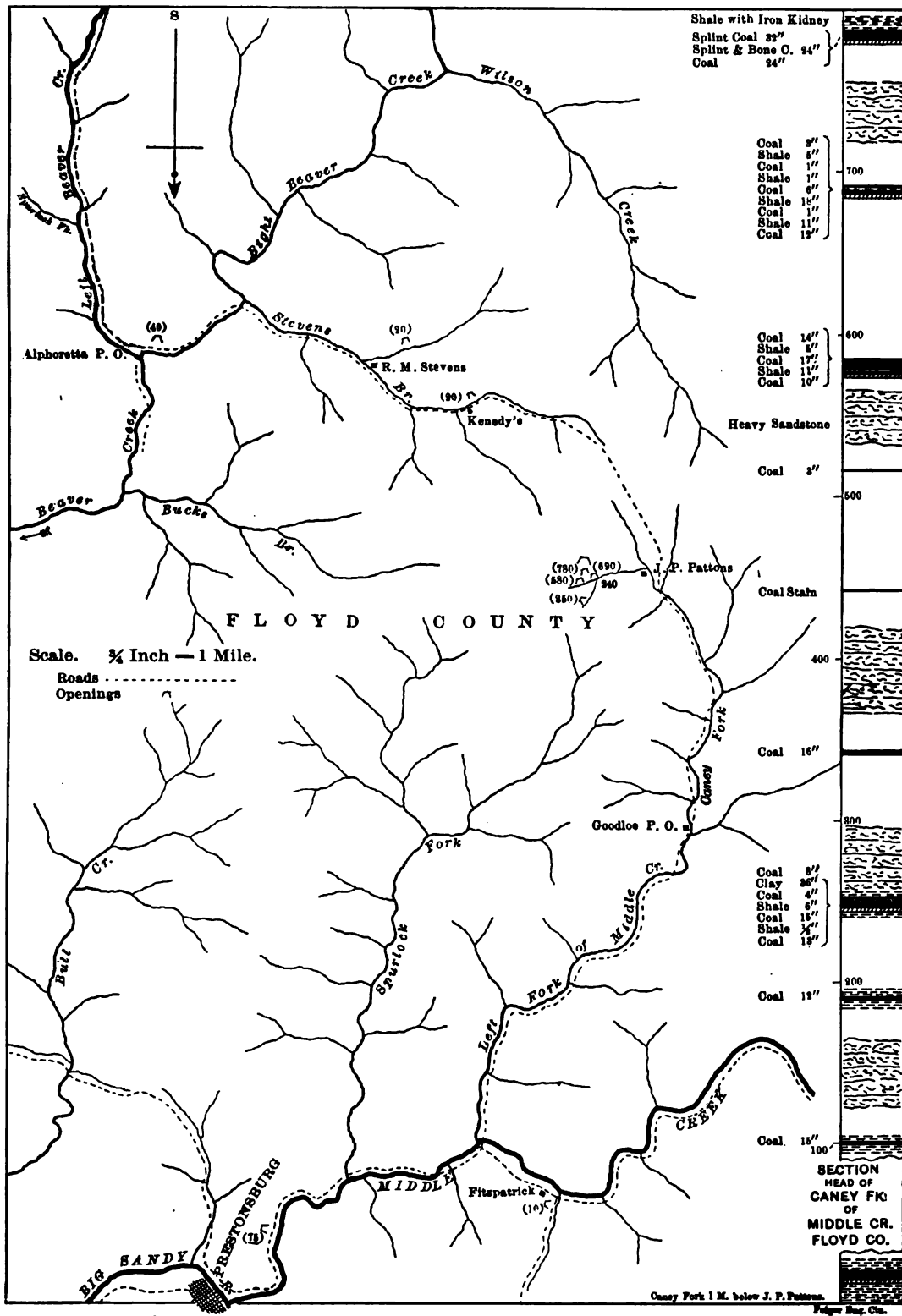
The locality chosen for tracing the series of coals in this region was the high hill at the head of Caney Fork of the Left Fork of Middle Creek. The beds found here exhibit an order of succession which makes the section as a whole readily comparable with those in the John's Creek valley. The lower coal, No. 1, is imperfectly shown along the creek above Goodloe postoffice, and is the same as the bed near the mouth of Middle Creek, 75 feet above the creek and on the Right Fork of Fitzpatrick's.

On the Beaver Creek side, this bed shows a thickened section, but with partings of shale included, giving rise to the impression that it is a different bed. As opened at Kenedy's, and on the branch at R. M. Stevens', and near the forks of Beaver Creek at Alphoretta postoffice, the following sections are found:



An average sample from the Stevens opening gives the following:

Moisture	1.60
Volatile combustible matter	34.10
Fixed carbon	57.70
Ash	6.60
	100.00
Sulphur	0.412



MIDDLE AND BEAVER CREEK REGION.

The Peach Orchard bed has been noted at a number of points as on Sugar Loaf branch above Prestonsburg as a prominent bed, though here too much broken with partings to be of special economic interest. The great bed of the region in point of thickness is near the top of the hill. It is without parting, but the percentage of ash is increased by thin layers of hard earthy coal or bone coal; not so much, however, as was anticipated from an examination of the bed as opened. The bed was opened by a shaft showing the whole thickness well protected by unbroken roof. Following is the bed-section:

Shale with Iron Kidneys.	
Splint coal	32 inches.
Splint and bone coal	24
Coal	24
Total	80 inches.

Following is an analysis of a sample taken from whole thickness, 80 inches:

Moisture	2.66
Volatile combustible matter	38.74
Fixed carbon	57.80
Ash	5.80
	100.00
Sulphur	0.489

It will be noticed that this bed has the same surroundings as the upper bed on the head of Left Beaver, Mud and Hurricane Creeks. It will be found in the highest hills in the Middle Creek region and along the valleys of the main forks of Beaver Creek. The bony appearance of layers of the middle bench does not, as would be expected, indicate a noticeable increase of ash.

Compare the vertical section with that of the preceding region.

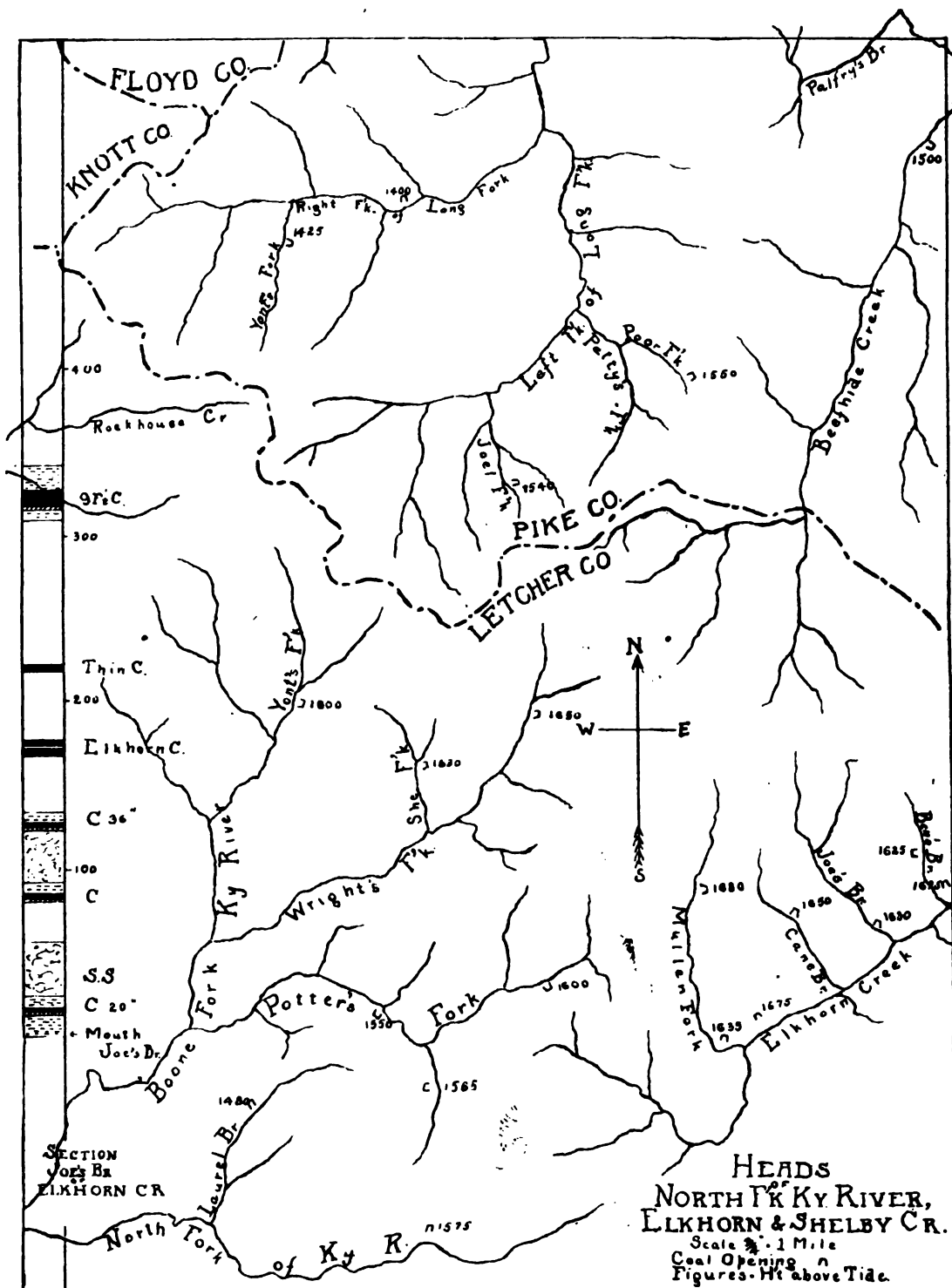
Region of Heads of North Fork of Kentucky River, Elkhorn and Shelby Creeks.

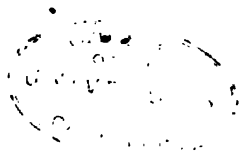
In this region, which is one of the most important, in the Eastern Kentucky field, only one coal, the Lower Elkhorn, is well developed. From this region the bed took its name, being developed by the Kentucky Geological Survey on the Elkhorn Creek and traced across to the adjoining Kentucky river drainage in 1880 and 1881.

The vertical section at the left of page map shows the relation of this coal to the beds next below and above near the head of Elkhorn Creek. The upper coal is probably the equivalent to the Upper Elkhorn seam, but it is too much banded by layers of clay and slate to be of more than geological interest so far as noted in this locality. The bed next below the Elkhorn seam showed 42 inches of good coal at the mouth of Mullins Fork, but there is in general no more than 30 to 36 inches as exposed in this locality.

The following tabular description of the Elkhorn seam for this map region shows a large field with little variation. Approximate elevations in feet above tide and above drainage are given. Thickness of bed-section is in inches, reading downward.

Locality.	Above Tide.	Above Creek.	Bed Section.	
N. Fk. Ky. River, near Head . . .	1575	250	Roof S.	C24, S 4, C 88, S 3, C 21. Total of bed, 90.
Laurel Br., N. Fk.	1480	145	" "	C 68, S 7, C 2, S 2. Total of bed, 79.
Potter's Fk., N. Fk.	1565	190	" "	C 47, S 4, C 44. Total of bed 95.
" " "	1550	215	" "	C 48, S 4, C 44. Total of bed, 96.
" " "	1600	150	" "	C 40, S 3½, C 80, S 2, C 24. Total of bed, 99½
Wright's Fk. "	1680	..	" "	C 45, S 5, C 80. Total of bed 80.
" " "	1650	..	" "	C 84, on outcrop.
Yont's Fk. Boone Fk.	1600	183	" "	C 45, S 5, C 24. Total of bed, 74.
Mullen's Fk. of Elkhorn Cr. . . .	1680	at Cr.	" "	C 48, S 4, C 49. Total of bed, 96.





Locality.	Above Tide.	Above Creek.	Bed Section.
Mullen's Fk., near mouth	1675	90	Roof S. O 54, S 16, C 32. Total of bed, 102.
Cane Br. of Elkhorn Cr.	1650	100	" " O 40, S 4, C 47. Total of bed, 91.
Elkhorn Cr., Potter's Cr.	1625	105	" " O 42, S 7, C 58. Total of bed, 107.
Ben's Br., Elkhorn Cr.	1625	105	" " O 48, S 5, C 51. Total of bed, 99.
2 M. below Ben's Br. (Peak's Br.) .	1600	175	" " O 41, S 10, C 72. Total of bed, 128.
Left Fk., Long Fk. of Shelby . .	1550	270	" " C 39, S 1½, C 28. Total of bed, 68½.
Same	1540	..	" " O 41, S 8, C 28. Total of bed, 67.
Beefhide Cr.	1515	485	" " C 22, S 2, C 30. Total of bed, 54.
Same	1520	475	" " C 40, S 14, C 26. Total of bed, 80.
Yont's Fk., Rt. Fk. of Long Fk. .	1425	180	" " C 45, S 5, C 28. Total of bed, 78.
Rt. Fk., Long Fk.	1400	210	" " C 59, S 8, C 38. Total of bed, 105.

Some of these openings are outcrop facings only, which do not show the character of the coal nor the exact details of bed-section. Altogether they show a large area of the maximum thickness of this bed. Results of coking tests in open heaps and at various coking plants leave no question as to coking qualities of the bed as a whole. This is not always indicated by the structural features, which vary from fracture planes by which the coal is easily reduced to small cubes, to hard splinty coal in considerable percentage.

The following table of analyses is made up from available determinations by McCreath for parties interested in the region, from samples collected with reference to reliable average results. Most of these openings were made after the Kentucky Geological Survey was suspended, in 1892:*

Locality.	El. A. T.	Thickness		Vol.				
		Inches.	Water.	C. M.	Fix. O.	Ash.	Sul.	Pho.
Potter's Fk., Ky. R. 1600		83	1.950	37.850	57.867	2.800	.538	..
Same, 48-hr. Coke . . .		..	0.802	1.623	91.320	6.165	.590	..
Same, 72-hr. Coke . . .		..	0.170	1.135	91.731	6.506	.459	..
Hd. Elkhorn . . . 1680		89	1.930	36.950	58.247	2.390	.598	..
Same, 48-hr. Coke . . .		..	0.090	1.220	92.353	5.860	.477	..

*The Survey was not revived until March 5, 1904.

Locality.	El. A. T.	Thickness		Vol.					
		Inches.	Water.	C. M.	Fix. C.	Ash	Sul.	Pho.	
Same, 72-hr. Coke . . .	. .	. .	0.074	0.791	90.920	7.750	.465	. .	
Ben Br. Hd. Elkhorn 1625		92	1.980	36.170	57.428	8.880	.597	. .	
Same, 48-hr. Coke . . .	. .	. .	0.280	1.335	90.050	7.885	.450	.008	
Same, 72-hr. Coke . . .	. .	. .	0.178	1.267	89.878	8.170	.507	. .	
Left Fk. Long Fk. of Shelby Cr.	. .	67	1.870	36.250	57.984	8.250	.696	. .	
Same, 48-hr. Coke . . .	. .	. .	0.150	1.106	90.468	7.680	.592	. .	

The following analyses were made by Dr. Robert Peter before the Survey work was suspended, in 1892, from samples collected by the writer as indicated. Samples from whole bed:

Locality.	Thickness		Vol.				
	El. A. T.	Inches.	Water.	C. M.	Fix. C.	Ash	Sul.
Laurel Br. N. Fk. Ky. River,	1480	94	3.260	32.24	61.60	2.90	.656
Same, lower	..	68	2.86	31.54	62.10	3.50	.535
Mullen's C.	1680	89	2.60	34.20	60.80	2.40	.412
Mullen's open hp Coke	..	89	1.06	..	90.40	8.54	.598
Mullen's lower bench	..	49	2.00	33.50	60.50	3.96	.429
Mullen's upper bench, coked open	..	41	1.10	..	95.40	3.50	.517
Cane Br. C. upper	..	40	6.00	31.26	59.34	3.40	.390
Cane Br. C. lower	..	47	2.54	32.26	62.20	3.00	.547

The vertical section presented by the Marrowbone-Flat Woods region includes all the equivalents of the coal measures above the Conglomerate series north of the Pine Mountain uplift, with such variations of order, thickness and character of beds as should hardly have been expected in even so large a field. South of the Pine Mountain a greater thickness of coal measures above the Conglomerate series is found, with the coal beds distributed vertically in an order which will doubtless be found comparable, in a general way at least, with the order of deposition of the coal measures north of that long mountain barrier. But any particular comparisons with reference to the equivalency of coal beds in the Eastern Kentucky field, may well be left until a more detailed study has been extended over the whole field.

The regional sections for the field covered by this report are necessarily incomplete as a showing of all the coal horizons, and the

changes of the thickness and character which beds undergo in their places in the series; but they are in more than a general way each a key to the vertical distributions of the beds in the regions represented. They will also serve to supply much data for a general discussion of questions of equivalency of beds and of nomenclature as these questions assume importance with the progress of the work.

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